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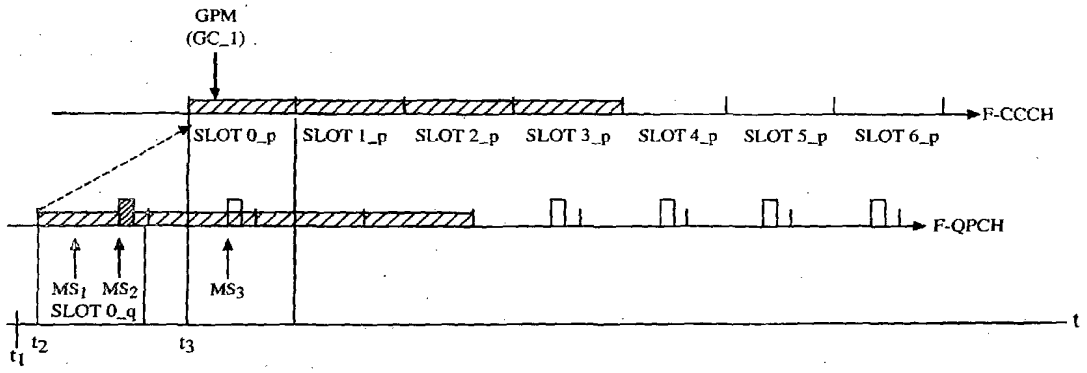
(54) Title: METHOD AND SYSTEM FOR A MULTICAST SERVICE INITIATION IN A COMMUNICATION SYSTEM



(57) Abstract: Method and a system for multicast service notification in cellular telephone system to enable the cellular telephone systems to provide both multicast and point-to-point services are disclosed. Several embodiments describe the signaling interaction between an access network and subscriber stations belonging to a multicast group to allow the access network to properly notify the subscriber stations of a the multicast service. Such a signaling further allows the subscriber stations to recognize the multicast service notification to participate in the multicast service.

WO 2004/006615 A1

METHOD AND SYSTEM FOR A MULTICAST SERVICE INITIATION IN A COMMUNICATION SYSTEM

BACKGROUND

Field

[1001] The present invention relates to multicast communications, in a wireline or a wireless communication system. More particularly, the present invention relates to a system and method for a multicast service initiation in such a communication system.

Background

[1002] Communication systems have been developed to allow transmission of information signals from an origination station to a physically distinct destination station. In transmitting an information signal from the origination station over a communication channel, the information signal is first converted into a form suitable for efficient transmission over the communication channel. Conversion, or modulation, of the information signal involves varying a parameter of a carrier wave in accordance with the information signal in such a way that the spectrum of the resulting modulated carrier wave is confined within the communication channel bandwidth. At the destination station, the original information signal is reconstructed from the modulated carrier wave received over the communication channel. In general, such a reconstruction is achieved by using an inverse of the modulation process employed by the origination station.

[1003] Modulation also facilitates multiple-access, i.e., simultaneous transmission and/or reception, of several signals over a common communication channel. Multiple-access communication systems often include a plurality of remote subscriber units requiring intermittent access of relatively short duration rather than continuous access to the common communication channel. Several multiple-access techniques are known in the art, such as time division multiple-access (TDMA), and frequency division multiple-access

(FDMA). Another type of a multiple-access technique is a code division multiple-access (CDMA) spread spectrum system that conforms to the "TIA/EIA/IS-95 Mobile Station-Base Station Compatibility Standard for Dual-Mode Wide-Band Spread Spectrum Cellular System," hereinafter referred to as the IS-95 standard. The use of CDMA techniques in a multiple-access communication system is disclosed in U.S. Patent No. 4,901,307, entitled "SPREAD SPECTRUM MULTIPLE-ACCESS COMMUNICATION SYSTEM USING SATELLITE OR TERRESTRIAL REPEATERS," and U.S. Patent No. 5,103,459, entitled "SYSTEM AND METHOD FOR GENERATING WAVEFORMS IN A CDMA CELLULAR TELEPHONE SYSTEM," both assigned to the assignee of the present invention.

[1004] A multiple-access communication system may be a wireless or wire-line and may carry voice traffic and/or data traffic. An example of a communication system carrying both voice and data traffic is a system in accordance with the IS-95 standard, which specifies transmitting voice and data traffic over the communication channel. A method for transmitting data in code channel frames of fixed size is described in detail in U.S. Patent No. 5,504,773, entitled "METHOD AND APPARATUS FOR THE FORMATTING OF DATA FOR TRANSMISSION", assigned to the assignee of the present invention. In accordance with the IS-95 standard, the data traffic or voice traffic is partitioned into code channel frames that are 20 milliseconds wide with data rates as high as 14.4 Kbps. Additional examples of communication systems carrying both voice and data traffic comprise communication systems conforming to the "3rd Generation Partnership Project" (3GPP), embodied in a set of documents including Document Nos. 3G TS 25.211, 3G TS 25.212, 3G TS 25.213, and 3G TS 25.214 (the W-CDMA standard), or "TR-45.5 Physical Layer Standard for cdma2000 Spread Spectrum Systems" (the IS-2000 standard).

[1005] In a multiple-access wireless communication system, communications between users are conducted through one or more base stations. The term user refers to both animate and inanimate entities. A first user on one wireless subscriber station communicates to a second user on a second wireless subscriber station by conveying information signal on a reverse link to a base station. The base station receives the information signal and

conveys the information signal on a forward link to the second subscriber station. If the second subscriber station is not in the area served by the base station, the base station routs the data to another base station, in whose service area the area the second subscriber station is. The second base station then conveys the information signal on a forward link to the second subscriber station. The forward link refers to transmission from a base station to a wireless subscriber station and the reverse link refers to transmission from a wireless subscriber station to a base station. Likewise, the communication can be conducted between a first user on a wireless subscriber station and a second user on a landline station. A base station receives the data from the first user on the wireless subscriber station on a reverse link, and routes the data through a public switched telephone network (PSTN) to the second user on a landline station. In many communication systems, e.g., IS-95, W-CDMA, IS-2000, the forward link and the reverse link are allocated separate frequencies.

[1006] The above described wireless communication system is an example of a point-to-point service, where information from the first user is intended for the second user only. In contrast, a multicast service is a service where the information provided by a source, a user or a content server, is intended for a subset of all users. A model of a multicast system comprises a selected group of users, defined by the user's group membership. The group membership comprises users of subscriber stations subscribed to a particular multicast content. For brevity, the term "member subscriber station" is used to mean "user on a subscriber station" unless stated otherwise.

[1007] In one such a model the member subscriber stations are provided information with a certain content, e.g., news, movies, sports events and the like by one or more content servers via an assess network. The term access network is used herein to mean a collection of base stations and one or more base stations' controllers. Each member subscriber station monitors a forward link channel, over which the information is conveyed. The forward link channel may be shared among the member subscriber stations or may be established between each member subscriber station and the access network's station, e.g., a base station serving the member subscriber station. Because

the content server fixedly determines the content, the member subscriber stations are generally not communicating back to the access network.

[1008] Alternatively, the source of information is a user, a member of the selected group; the user providing information intended for the remaining members of the selected group. If the user wishes to provide information, the user notifies the communication system, e.g., by pressing a push-to-talk (PTT) button. Typically, the user provided information is routed from the subscriber station to a base station on a dedicated reverse link. The base station then conveys the user provided information over a multicast forward link. As in case of the point-to-point communication system, the multicast communication system allows both landline and wireless subscriber station to access the system. The above-described service is also referred to as a group service. Examples of group service communication systems include dispatch services, such as local police radio systems, taxicab dispatch systems, Federal Bureau of Intelligence and Secret Service operations, and general military communication systems.

[1009] The above-mentioned multicast service communication systems are generally highly specialized purpose-build communication systems. With recent advancements in wireless cellular telephone systems there has been an interest in utilizing the existing infrastructure of the (mainly point-to-point) cellular telephone systems for multicast services. (As used herein, the term "cellular" systems encompasses both cellular and PCS frequencies.)

[1010] Introduction of a multicast services to cellular telephone systems requires integration of multicast services with the point-to-point services provided by the current cellular telephone systems. Specifically, both the access network and the subscriber station need to be able support functions allowing both the multicast mode and point-to-point communication mode. Because the point-to-point cellular telephone systems do not support multicast services, there is a need in the art for a method and a system for a multicast service procedures, specifically a multicast service initiation.

SUMMARY

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[1011] Embodiments disclosed herein address the above stated needs by determining a multicast group identifier; and including the multicast group identifier in at least one periodically repeated message on a first channel. The subscriber station monitors the periodically repeated message on the channel; and decoding the periodically repeated message to determine if a multicast service notification was included in the periodically repeated message.

[1012] In another embodiment the above stated needs are addressed by determining identity of subscriber stations belonging to a multicast group; determining a slot of a channel in accordance with the identity of a subscriber station; and transmitting a multicast service notification in the slot on a channel. The subscriber station monitors the slot of a channel; and decodes the message conveyed in the slot to determine if a multicast service notification was included in the message.

[1013] In another embodiment the above stated needs are addressed by including an indicator into a pre-determined slot on a first channel; and including a multicast service notification into a message conveyed in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator. The subscriber station decodes the indicator from the pre-determined slot on the first channel; and decodes the multicast service notification in the slot on the second channel, the slot corresponding to the pre-determined slot on the first channel, if the multicast service notification was indicated by the indicator.

[1014] In another embodiment the above stated needs are addressed by including an indicator into a first slot on a first channel; and including a multicast service notification into a message conveyed in a second slot on a second channel, the second slot corresponding to the first slot, if a multicast service notification was indicated by the indicator. The subscriber station decodes the indicator from the first slot on the first channel; and decodes the multicast service notification in the second slot on the second channel, the second slot corresponding to the first slot, if the multicast service notification was indicated by the indicator.

[1015] In another embodiment the above stated needs are addressed by establishing a link layer protocol between a subscriber station

belonging to a multicast group and a source of a multicast service; and conveying the multicast service notification over the link layer protocol. The subscriber station participates in establishing the link layer protocol; and receives the multicast service notification over the link layer protocol.

BRIEF DESCRIPTION OF THE DRAWINGS

[1016] **FIG. 1** illustrates a conceptual block diagram of a communication system capable of providing multicast services in accordance with embodiments of the present invention;

[1017] **FIG. 2** illustrates a message flow in accordance with one embodiment of notification;

[1018] **FIG. 3** illustrates conceptual diagram of a page message;

[1019] **FIG. 4** illustrates a message flow in accordance with another embodiment of notification;

[1020] **FIG. 5** illustrates a relationship between signaling conveyed over a Forward Quick paging channel and signaling conveyed over a Forward Common Control Channel or a Forward Paging Channel in one embodiment;

[1021] **FIG. 6** illustrates a message flow in accordance with another embodiment of notification;

[1022] **FIG. 7** illustrates a relationship between signaling conveyed over a Forward Quick paging channel and a Forward Common Control Channel or a Forward Paging Channel in accordance with another embodiment; and

[1023] **FIG. 8** illustrates a message flow in accordance with another embodiment of notification;

[1024] **FIG. 9** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1025] **FIG. 10** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1026] **FIG. 11** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1027] **FIG. 12** illustrates a message flow in accordance with another embodiment of response/channel assignment;

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[1028] **FIG. 13** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1029] **FIG. 14** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1030] **FIG. 15** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1031] **FIG. 16** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1032] **FIG. 17** illustrates a message flow in accordance with another embodiment of response/channel assignment;

[1033] **FIG. 18** illustrates a message flow in accordance with another embodiment of response/channel assignment; and

[1034] **FIG. 19** illustrates a message flow in accordance with another embodiment of response/channel assignment.

DETAILED DESCRIPTION

Definitions

[1035] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments.

[1036] The terms point-to-point communication is used herein to mean a communication between two subscriber stations over a dedicated communication channel.

[1037] The terms group service, point-to-multipoint communication, push-to-talk, or dispatch service are used herein to mean a communication wherein a plurality of subscriber stations are receiving communication from – typically – one subscriber station.

[1038] The term access network is used herein to mean a collection of base stations (BS) and one or more base stations' controllers. The access network transports data packets between multiple subscriber stations.

The access network may be further connected to additional networks outside the access network, such as a corporate intranet or the Internet, and may transport data packets between each access terminal and such outside networks.

[1039] The term base station is used herein to mean the hardware with which subscriber stations communicate. Cell refers to the hardware or a geographic coverage area, depending on the context in which the term is used. A sector is a partition of a cell. Because a sector has the attributes of a cell, the teachings described in terms of cells are readily extended to sectors.

[1040] The term subscriber station is used herein to mean the hardware with which an access network communicates. A subscriber station may be mobile or stationary. A subscriber station may be any data device that communicates through a wireless channel or through a wired channel, for example using fiber optic or coaxial cables. A subscriber station may further be any of a number of types of devices including but not limited to PC card, compact flash, external or internal modem, or wireless or wireline phone. A subscriber station that is in the process of establishing an active traffic channel connection with a base station is said to be in a connection setup state. A subscriber station that has established an active traffic channel connection with a base station is called an active subscriber station, and is said to be in a traffic state.

[1041] The term physical channel is used herein to mean a communication route over which a signal propagates described in terms of modulation characteristics and coding.

[1042] The term logical channel is used herein to mean a communication route within the protocol layers of either the base station or the subscriber station.

[1043] The term communication channel/link is used herein to mean a physical channel or a logical channel in accordance with the context.

[1044] The term reverse channel/link is used herein to mean a communication channel/link through which the subscriber station sends signals to the base station.

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[1045] A forward channel/link is used herein to mean a communication channel/link through which a base station sends signals to a subscriber station.

Detailed Description

[1046] As discussed, a model of a multicast system comprises a selected group of users, defined by the user's group membership. The group membership comprises users of subscriber stations subscribed to a particular multicast content. One or more content servers or another user provides the multicast content. **FIG. 1** illustrates a conceptual diagram of a communication system **100** capable of providing multicast services (also referred to as a multicast call), in accordance with embodiments of the present invention.

[1047] As discussed, the multicast content may originate at a content server (CS). The content server may be located within the network, CS1 **102(1),** or outside Internet (IP) **104**, CS2 **102(2).** The content may be delivered in a form of packets to a multicast packet data-serving node (MPDSN) **106.** The term MPSDN is used because although the MPDSN may be physically co-located or provide functionality identical to the regular PDSN (not shown), the MPSDN may be logically different from a regular PDSN. According to the packet's destination, the MPDSN **106** delivers the packets to a packet control function (PCF) **108.** The PCF is a control entity controlling function of base stations **110** for any packet data services including the multicast packet data services like a base station controller is for regular voice traffic and data traffic services. To illustrate the connection of the high level concept of the multicast packet data services with the physical access network, **FIG. 1** shows that the PCF is physically co-located, but logically different from a base station controller (BSC). One of ordinary skills in the art understands that this is for pedagogical purposes only. The BSC **108** provides the packets to base stations **110.** Although the term base station is used, one of ordinary skills in the art recognizes that the embodiments are equally applicable to sectors.

[1048] Similarly, if the content originates in the CS **102(1),** the content may be delivered to a public switched telephone network (PSTN) **112.**

According to the content destination, the PSTN **112** delivers the content to base station controller BSC **108**. The BSC **108** provides the content to base stations **110**.

[1049] In yet another embodiment, the content, originating in the CS **102(1)** may be delivered in the form of packets via an interworking function **120** to the PSTN **112**. According to the content destination, the PSTN **112** delivers the content to base station controller BSC **108**. The BSC **108** provides the content to base stations **110**.

[1050] The base station **110** provides the content over a forward channel **114** to the member subscriber stations. As discussed, the forward channel may be shared among the member subscriber stations or established between each member subscriber station and the base station, serving the member subscriber station. A use of a shared forward channel is disclosed in a co-pending U.S. Patent Application Serial No. 10/113,257, entitled " METHOD AND APPARATUS FOR POINT-TO-MULTIPOINT SERVICES PROVIDED IN COMMUNICATION SYSTEMS", filed March 28, 2002. The use of common and dedicated channels for information broadcast is disclosed in a co-pending U.S. Patent Application Serial No. 10/113,098, entitled "METHOD AND APPARATUS FOR CHANNEL MANAGEMENT FOR POINT-TO-MULTIPOINT SERVICES IN A COMMUNICATION SYSTEM", filed March 28, 2002, and assigned to the assignee of the present invention. However, one of ordinary skills in the art understands that recited applications are for tutorial purposes only, and other communication systems utilize channels performing similar function, therefore, the teaching is applicable to other communication systems.

[1051] Alternatively, a member subscriber station, e.g., member subscriber station **116(1)**, communicates multicast content to other member subscriber stations, e.g., a member subscriber station **116(2)**, via an access network. The member subscriber station **116(1)**, communicates the multicast content to the group over a reverse link channel **118**, assigned to the subscriber station **116(1)** by the access network. Reverse link channel assignment is well known in the art, refer e.g., to the above mentioned applications serial numbers 10/113,257 and 10/113,098. The base station **110(1)** routes the received information to the base station **110(2)**, and the base station **110(2)** then transmit

3NSDOCID: <WO____2004006615A1_I_>

the routed information over the forward channel **114(2)** to the member subscriber station **116(2).**

[1052] When a multicast service is to be provided, a procedure enabling a multicast call commencement must be followed. Such a procedure may be separated into several stages. During the first stage, member subscriber stations for whom the multicast service is to be provided must be notified. During the next (optional) stage, the interested member subscriber stations respond to the notification. During the next stage, a channel over which the content will be conveyed is selected and assigned.

Notification of Multicast Call Commencement

[1053] As discussed above, when a multicast call is to be initiated, the subscriber stations that are members of the multicast group must be notified.

[1054] In one embodiment, the access network initiates the multicast call by broadcasting the notification information to the subscriber stations via a periodically transmitted message, e.g., an overhead message. The term overhead message is used herein to mean a message pertaining to system parameters, periodically transmitted by each sector. The overhead message, containing the multicast call notification is transmitted by the sectors, whose coverage area contains member subscriber stations, on a forward channel that is monitored by all subscriber stations not engaged in another call. An example of such an arrangement in a communication system in accordance with the IS-2000 standard is an overhead message transmitted on a forward paging channel (F-PCH) or a forward broadcast control channel (F-BCCH).

[1055] The multicast call is advertised by including an identifier of the multicast group (GROUP_ID), for whose member subscriber stations the multicast call is intended, into the overhead message. If more than one multicast call is being initiated, the overhead message contains the identifiers of all the multicast groups, for which the multicast calls are intended. The identifier may be sent in one overhead message; several overhead messages, or be included in all overhead messages for the duration of the multicast call. The

last option allows subscriber stations to join already pending multicast call. If the identifier is included in the overhead message for the duration of the multicast call, upon termination of a multicast call for a specific multicast group, the specific multicast group identifier is removed from the message. In addition to the identifier, the overhead message may provide further information relevant to the advertised multicast call, e.g., the type of traffic channel assignments, type of bearer transport used, and other relevant information known to one of ordinary skills in the art. Of course, the remaining parts of the overhead message comprise system related information as discussed above.

[1056] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 2**. At an instant t_1, a sector **S** receives an indication **GROUP_IDx** that a multicast call intended for group with an identifier GROUP_IDx is to start. The indication may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. Alternatively, the sector **S** receives identity of the subscriber stations **MS_1** and **MS_2.** The sector **S** then determines the identifier of the multicast group **GROUP_IDx** comprising the subscriber stations **MS_1** and **MS_2,** e.g., by querying a database. As discussed, the source of information may comprise, e.g., a server, another subscriber station, or any other source known to one skilled in the art. The sector **S** includes the identifier in the overhead message, which in one embodiment comprises a broadcast system parameters message **BSPM(GROUP_IDx),** and broadcasts the **BSPM(GROUP_IDx)** at time t_2. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **BSPM(GROUP_IDx)** and take an appropriate action, e.g., start monitoring the physical channel on which the identified multicast call is being transmitted, to transmit a response to the access network, to notify the user, and other actions in accordance with design of a specific communication system. **FIG. 2** shows an embodiment, in which the identifier is included in the overhead message for the duration of the multicast call. Because the overhead message **BSPM** repeats periodically, the identifier is, likewise, transmitted in the next instance(s) of the overhead message **BSPM.** Only one instance at time t_3 is shown.

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[1057] At an instant t_4, the sector **S** receives an indication **GROUP_IDy** from a source of information (not shown) that a multicast call intended for group with an identifier GROUP_IDy is to start. The sector **S** includes the identifier into the overhead message, e.g., the **BSPM.** Because two groups are being notified about the multicast call, the broadcasted overhead message transmitted at an instant t_5 contains both identifiers **BSPM(GROUP_IDx, GROUP_IDy).** Subscriber station **MS_3** that is a member of the group with the identifier GROUP_IDy receives the overhead message **BSPM(GROUP_IDx, GROUP_IDy),** and takes an appropriate action as described above.

[1058] At an instant t_6, the sector **S** receives an indication **GROUP_IDx ends** from the source of information (not shown) that a multicast call intended for group with an identifier GROUP_IDx is to terminate. The sector **S** removes the identifier from the overhead message, e.g., the **BSPM,** and broadcasts the overhead message, containing only the identifier GROUP_IDy, **BSPM(GROUP_IDy),** at an instant t_7. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier GROUP_IDx receive the overhead message **BSPM(GROUP_IDy),** and take an appropriate action, e.g., to terminate monitoring the physical channel on which the multicast call corresponding to the identifier GROUP_IDy is being transmitted. The multicast call **BSPM(GROUP_IDy)** is unaffected and continues until terminated. Upon termination, the identifier GROUP_IDy is removed from the BSPM.

[1059] Because the broadcast message is repeated periodically, subscriber stations can join the call anytime after the start of the call. To prevent the broadcast message from affecting the paging channel capacity, it is desirable to limit the broadcast message length. Consequently, the number of groups that may be included in the broadcast message is limited. Additionally, because the broadcast message changes with each call start and termination, the subscriber stations must monitor every update of the broadcast message. In another embodiment, each subscriber station that is a member of a multicast group is notified about a start of a multicast call by an individual message addressed to the subscriber station. In one embodiment, the individual message comprises an individual multicast page (MCP). The concept of an

individual MCP is explained in the context of a communication system in accordance with the IS-2000 standard. As conceptually illustrated in **FIG. 3**, a page message **300** may carry many pages **302**, each destined for a different subscriber station or group of subscriber stations. The page message **300** may comprise, e.g., a general page message (GPM) or universal page message (UPM) because either the GPM or the UPM can carry different page record types. The page message is conveyed over the F-PCH or a forward common control channel (F-CCCH). The individual pages **302** carried in a page message are referred to as page record types, each page record type comprising an address of the destined subscriber station(s) **306**, a type of the page **308** (i.e., individual or broadcast), a content **310** (i.e., the service option of the call), and other information, e.g., sequence number **304**. The addressing is specified in a page address type (ADDR_TYPE), e.g., a Temporary Mobile Station Identifier (TMSI), an international mobile station identifier (IMSI), for individually addressing a subscriber station, or an address type for addressing all subscriber stations. Upon receiving the page message **300**, the subscriber station decodes address **306** to determine whether the page **302** is intended for the subscriber station or not. If the address **306** indicates that the page **302** is intended for the subscriber station, the subscriber station decodes the type **308** to determine the type of call, and the content **310**, to determine the details of the call. Each type of a call, i.e., a voice call, a data call, an SO33 call in a point-to-point communication system has a corresponding page record. Because, as discussed, the multicast call is a new type of a call, the individual MCP must be defined as a new page record type.

[1061] The multicast call is advertised by including an identifier of the multicast group (GROUP_ID) into the individual MCP. The individual MCP is included in a page message and sent over a forward channel, e.g., the F-PCH or the F-CCCH, to the member subscriber stations, using the member subscriber stations' specific address. Additionally, the MCP may provide further information relevant to the advertised call, e.g., the type of traffic channel assignments, type of bearer transport used, and other relevant information known to one of ordinary skills in the art.

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[1062] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 4**. At an instant t_1, a sector **S** receives an indication **GROUP_IDx** that a multicast call intended for group with an identifier GROUP_IDx is to start. The indication may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. The sector **S** then determines the identity of the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. Alternatively, the sector **S** receives identity of the subscriber stations **MS_1** and **MS_2.** The sector **S** then creates an individual MCP containing the identifier GROUP_IDx for subscriber stations **MS_1** and **MS_2**.

[1063] One of ordinary skills in the art appreciates that a paging channel may operate in a slotted or non-slotted paging mode because such modes are described in documents known to ordinarily skilled artisans. As an example, such modes are described in the IS-95 standard, U.S. Patent No. 5,392,287, entitled "METHOD AND APPARATUS FOR REDUCING POWER CONSUMPTION IN A MOBILE COMMUNICATION RECEIVER," issued February 21, 1995, assigned to the assignee of the present invention. For tutorial purposes **FIG. 4** illustrates a configuration communication system, in which the subscriber stations monitor the F-PCH or the F-CCCH in a slotted mode; however, one of ordinary skills in the art would understand that a non-slotted mode may be used. As one of ordinary skills in the art understands, the term slot refers to a partition of a physical channel with a length expressed in time, number of chips or other appropriate unit.

[1064] The sector **S** waits until time t_2 for the paging slot assigned to the subscriber station **MS_1**, and then conveys the individual MCP for **MS_1** as part of a page message, e.g., the GPM, as shown. The subscriber station **MS_1** then may take an appropriate action, e.g., to initiate monitoring the physical channel on which the multicast call corresponding to the identifier GROUP_IDx is being transmitted, to transmit a response, to notify the user, and other actions in accordance with design of a specific communication system. The sector **S** then waits until time t_3 for the paging slot assigned to the subscriber station **MS_2**, and then conveys the MCP for **MS_2** as part of a page

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message, e.g., the GPM, as shown. The subscriber station **MS_2** then may take an appropriate action, as described above. In another embodiment, each member subscriber station is notified about a start of a multicast call by a common message addressed to the subscriber stations belonging to the group. In one embodiment, the common message comprises a common multicast page (MCP). As explained above, because the common MCP is intended for a multiple, but not all, subscriber stations, and because the multicast call is a new type of a call, the common MCP must be defined as a new page record type. Referring to the structure of a page message **300** in **FIG. 3** the new page record type **302** comprises a new page address, multicast address (MC_ADDRESS) **304**, specifying that the page record type **302** is intended for a multiple subscriber stations, as well as the type **308**, the content **310**, and other information, e.g., sequence number **304**.

[1066] The start of a new multicast call is advertised by including an identifier of the multicast group GROUP_ID, into the MCP for the member subscriber stations, belonging to the multicast group identified by the GROUP_ID. The common MCP is included in a page message and sent over a forward channel, e.g., the F-PCH or the F-CCCH, to the subscriber stations for which the common MCP is intended, using the MC_ADDRESS. Additionally, the MCP may provide further information relevant to the advertised call, e.g., the type of traffic channel assignments, type of bearer transport used, and other relevant information known to one of ordinary skills in the art. However, as explained above, in current communication systems, a subscriber station is assigned to monitor a paging channel slot in which a page for the subscriber station is to be sent. However, the subscriber stations belonging to the group identified by the GROUP_ID are not necessarily assigned the same slot on the paging channel. Furthermore, the entity, responsible for paging, e.g., a base station controller (BSC) may not know which subscriber stations are members of a particular multicast group, consequently, the BSC cannot perform the mapping between an individual subscriber station and the MC_ADDRESS. Such a scenario occurs e.g., when multicast service is provided over Internet protocol (IP) because the MCP is triggered due to receiving an IP packet over a multicast IP address. Therefore, a method enabling efficient method for

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delivering the multicast call initiation information is required. Consequently, in accordance with one embodiment, the common MCP is sent in the first slot of a broadcast paging cycle (BPC). The concept of BPC is explained in terms of a paging channel as implemented in a communication system in accordance with the IS-2000 standard. As illustrated in **FIG. 5**, the F-PCH and the F-CCCH are divided into slots. To enable periodic broadcast paging, a broadcast paging cycle is defined in terms of duration (in number of F-PCH/F-CCCH slots) given as follows:

$$BPC = B+X \quad (1)$$

where B is given as follows:

$$B = 2^i \times 16, \text{ where } 1 \le i \le 7 \text{ for F-PCH and } 2 \le i \le 8 \text{ for F-CCCH.} \quad (2)$$

and X is a fixed offset. For example in a communication system in accordance with the IS-2000 standard, the values are 3 on the F-PCH and 7 on F-CCCH.

[1068] The value of a broadcast index i (BCAST_INDEX) is transmitted by the sector in the Extended System Parameters Message (ESPM) for F-PCH and Multicarrier Radio Resource Parameters Message (MCRR) for F-CCCH.

[1069] A subscriber station in a slotted mode monitors a slot, is determined in accordance with the following equation:

$$B = 2^j \times 16, \text{ where } 1 \le j \le 7 \text{ for F-PCH and } 2 \le j \le 8 \text{ for F-CCCH} \quad (3)$$

where the value of a slot index j (BCAST_INDEX) is transmitted by the sector in the Extended System Parameters Message (ESPM) for F-PCH and Multicarrier Radio Resource Parameters Message (MCRR) for F-CCCH.

[1070] As a consequence, for any combination of the broadcast index i and a slot index j, there would be a collision between a broadcast slot, which the subscriber station monitors for broadcast in accordance with the

Equation (2), and a slot monitored by the subscriber station for individually addressed messages in slotted mode in accordance with the Equation (3). The collision would be repeated in the same slot; consequently, the subscriber station monitoring the particular slot would always encounter a collision between the multicast page and the individual page. Introduction of the offset X into Equation (2) resulting in Equation (1) does not completely eliminate the collision, but prevents the collision to occur in periodically in the same slot, therefore, the collision is spread among all the subscriber stations. Thus, each subscriber station can decode either message in a non-affected slot.

[1071] The first slot of each BPC is an F-PCH/F-CCCH slot, for which the following Equation holds:

$$t/4 \bmod (BPC) = t/4 \bmod (B + X) = 0, \quad (3)$$

where *t* represents system time expressed in frames; and

mod means a modulo arithmetic.

[1072] Such an arrangement would require each subscriber station to wake up and monitor not only a slot individually assigned to the mobile for other types of messages, but also every first slot of the BPC of the F-PCH/F-CCCH, thus, increasing power consumption. To avoid such power consumption, slots of a forward quick paging channel (F-QPCH), associated with a F-PCH/F-CCCH, contain Broadcast Indicator (BI) bits that are used to inform subscriber stations monitoring the F-QPCH about occurrence or non-occurrence of the common MPC on the first slot of the BPC of the corresponding F-PCH/F-CCCH. If there is a common MPC on the first slot of the BPC of the F-PCH/F-CCCH, the BI bits of the corresponding F-QPCH slot are turned ON, resulting in subscriber stations starting to monitor the first slot of the BPC on the F-PCH/F-CCCH. Although a subscriber station is required to wake up and monitor the BI bits of the first F-QPCH slot of the BPC, because the duration of the BI is much shorter than the duration of the slot of a F-PCH/F-CCCH, the wake up interval is shorter, therefore, battery consumption is achieved.

[1073] A disadvantage of the above-described embodiment is that because the MCP for all multicast calls are sent on the first slot of the BPC on

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the F-PCH/F-CCCH, the BI bits on the corresponding F-QPCH are set to ON, when the MCP is present. Consequently, each subscriber station monitoring the BI indicator must wake up and monitor the first slot on the F-PCH/F-CCCH to determine, whether the MCP is intended to the subscriber station. Therefore, the subscriber stations not belonging to the multicast group for which the MCP is intended still increase power consumption. As illustrated in **FIG. 5**, a GPM, containing a common MCP for subscriber stations MS_1 and MS_2 belonging to a multicast group (**GC_1**), is transmitted in the first slot of a BPC on the F-PCH/F-CCCH (**Slot 0_p**). However, because the BI bits in the corresponding slot of the F-QPCH (**Slot 0_q**) is set ON, all subscriber stations MS_1 – MS_4, must wake up and monitor the **Slot 0_p** of the F-PCH/F-CCCH. Similarly, a GPM, containing a common MCP for subscriber stations MS_3 belonging to a multicast group (**GC_2**) is transmitted in the first slot of the next BPC of the F-PCH/F-CCCH (**Slot 4_p**). Therefore, the BI bits in the corresponding slot of the F-QPCH (**Slot 4_q**) is set ON and all subscriber stations MS_1 – MS_4, must wake up and monitor the **Slot 4_p** of the F-PCH/F-CCCH, although the GPM contains only a common MCP intended for a subscriber station MS_3.

[1074] One of ordinary skills in the art recognizes that the above-described embodiment utilized the first slot of the BPC as a concession to an existing standard. Consequently, such a limitation is unnecessary in general, and any slot of the BPC pre-agreed upon by the access network and the subscriber stations can be used. Consequently, in accordance with another embodiment, the limitation that the MPC may be sent in only the first slot of a BPC on the F-PCH/F-CCCH is removed. For terminology consistency reasons, the term BPC is replaced by a term multicast paging cycle (MPCY). One of ordinary skills in the art understands that the concepts of BPC and MPCY are identical. Because it is still desired that a subscriber station does not wake up to monitor every slot of the F-PCH/F-CCCH, it is necessary to establish a procedure, allowing the sector to determine, in which slot to send a message to a particular multicast group, and allowing subscriber station(s) belonging to the multicast group to determine, which slot to monitor. The procedure is defined by a mapping function, e.g., a hash function, accepting input parameters, e.g.,

the total number of slots in the MPCY, and a GROUP_ID, and outputting a number, which identifies the slot, in which a paging message, containing common MPC for subscriber stations belonging to the multicast group identified by that GROUP_ID, will be transmitted. Alternatively, the mapping can be implemented as a table or any other algorithm mapping the GROUP_ID to a slot number. Because a subscriber station is given a GROUP_ID of each group, to which the subscriber station belong, e.g., upon subscription to the group; the subscriber station may use the hash function to determine the F-QPCH slot to monitor to read the BI indicator. This reduces the probability of false alarm, i.e., the subscriber station waking up for a MCP for a Multicast Group to which the subscriber station does not belong. One of ordinary skills in the art understands that a hash function has been used only as an example, and any other mapping function, allowing both the access network and the subscriber station arrive at the same slot given the same input parameters, is acceptable.

[1076] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 6**. At an instant t_1 a sector **S** receives an indication **GROUP_IDx** from a source of information (not shown) that a multicast call intended for group with GROUP_IDx, comprising subscriber stations **MS_1** and **MS_2** is to start. As discussed, such a source of information may comprise e.g., a server, another subscriber station, or another source. The sector **S** creates the common MCP containing the GROUP_IDx for subscriber stations **MS_1** and **MS_2**, and enters the GROUP_IDx together with the number of slots of the MPCY into a mapping function. Referring to **FIG. 7**, the hash function returns an indication that the MCP for the GROUP_IDx is to be sent in **Slot 0_p**. At an instant t_2, indicating beginning of slot (**Slot 0_q**) of F-QPCH corresponding to **Slot 0_p** of F_CCCH, the sector **S** sets BI bit to ON. The subscriber stations **MS_1** and **MS_2**, that used the same hashing function to determine which slot of F-QPCH to monitor, detect that the BI bit in the **Slot 0_q** is set to ON. The subscriber stations **MS_1** and **MS_2** then wake up for monitoring of **Slot 0_p** at instant t_3. At the instant t_3, indicating beginning of **Slot 0_p** the sector **S** transmits the MCP as a part of the page message, e.g., the GPM.

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[1077] As indicated in **FIG. 5**, **MS_3** is a member of a multicast group different from the multicast group indicated by GROUP_IDx. Because no request for multicast call for the multicast group to which MS_3 belong has been received, no notification is needed in **Slot 1_p** of the F_CCCH, and the BI bits in a slot of F-QPCH corresponding to **Slot 1_q** of F_CCCH, are set to OFF.

[1078] In another embodiment, the subscriber stations are informed about a multicast call over protocol layers higher than an air interface signaling layer. As is known in the art, layering is a method for organizing communication protocols in well-defined encapsulated data units between otherwise de-coupled processing entities, i.e., layers. The protocol layers are implemented in both base stations **110** and remote stations **116**. In accordance with the Open Systems Interconnection (OSI) model, protocol layer L1 provides for the transmission and reception of radio signals between the base station and remote station, layer L2 provides for the correct transmission and reception of signaling messages, and layer L3 provides for the control messaging for the communication system. Layer L3 originates and terminates signaling messages according to the semantics and timing of the communication protocol between a base station **110** and a remote station **116**. In a cdma2000 system, the air interface signaling layer L1 is referred to as the Physical Layer, L2 is referred to as the Link Access Control (LAC) Layer or the Medium Access Control (MAC) Layer, and L3 is referred to as the Signaling Layer. Above the Signaling Layer are layers, which in accordance with the OSI model are numbered L4-L7 and referred to as Transportation, Session, Presentation and Application Layers.

[1079] In accordance with the embodiment, a link layer session is established between the source of information and a subscriber station using an existing communication system interface. Such a link layer protocol can comprise, e.g., a point-to-point protocol (PPP), a Serial Line Internet Protocol (SLIP), or other link layer protocol known to one of ordinary skills in the art may be utilized without departing from the scope of the present invention. Link layer protocols are described in documents known to ordinarily skilled artisans, e.g., IS-707 standard. The multicast call notification message is then sent via Internet protocol (IP) connection of the link layer session.

[1080] **FIG. 8** illustrates an example of message flow in accordance with one embodiment. At an instant t_1, a sector **S** receives an indication **Page(MS_1)** from a source of information via a Packet Service Data Node **(PSDN)** that a multicast call intended for group comprising subscriber station **MS_1** is to start. The sector **S** generates a page record intended for the subscriber station **MS_1** for a call set-up requesting a PPP (**DP**). Because the requested call is a point-to-point type of a call, the page record is an individual for each member subscriber station. In accordance with an IS-707, such a service option is SO33. As discussed above, the service option is included in the content part of a page record. The sector **S** then generates an appropriate page message, e.g., a GPM, and waits until time t_2 for the paging slot assigned to the subscriber station **MS_1**. At time t_2, the page message is transmitted as a part of a **GPM(DP:SO33)** to **MS_1**. In one embodiment, the subscriber station **MS_1** acknowledges receipt of the MCP at time t_3. As illustrated in **FIG. 8**, in a communication system in accordance with the IS-2000 standard, the response comprises page response message (**PRM(SO33)**), which is modulated on a reverse channel, e.g. an access channel. At time t_4, the sector **S** sends a notification which channel is the multicast call to use. In a communication system in accordance with the IS-2000 standard such a notification is sent in an extended channel assignment message (**ECAM**). Consequently, an SO33 call is established on the channel assigned by the ECAM. Once the SO33 call is established, the PPP between the source **PDSN** and the subscriber station **MS_1** is established at time t_5. The **MS_1** is then notified about the multicast call commencement over the PPP. The remaining subscriber stations belonging to the multicast group and interested in the multicast call follow the above described procedure. (Only one additional subscriber station **MS_2** is shown for simplicity.) In accordance with another embodiment, upon receiving a notification about a multicast call to a group identified by a GROUP_ID from a source, the sector transmits a multicast addressed page record to all subscriber station in the group, for which the multicast call is intended, requesting establishment of a link layer protocol. As discussed above, the subscriber stations belonging to the group identified by the GROUP_ID are not necessarily assigned the same slot on the paging channel. Consequently, any of the

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solutions described above to properly deliver the multicast addressed page are applicable.

[1082] Once a subscriber station belonging to the group responds to the multicast addressed page by sending a PRM, the sector sets up the link layer protocol, e.g., a SO33 call with the subscriber station as described above, and notifies the subscriber station are about the multicast call commencement over the link layer protocol. The link layer protocol call set up and the notification is then repeated for each remaining subscriber station. Such an individual link layer protocol set up is possible because although the access network did not necessarily know the identities of the individual subscriber station upon sending the multicast addressed page, upon receiving the responses from subscriber stations the identities were revealed.

Response to Notification of Multicast Call Commencement

[1083] As discussed above, when a multicast call is to be initiated, the subscriber stations that are members of the multicast group must be notified. Once a subscriber station receives a notification that a multicast call is commencing, there are several alternatives for whether and how the subscriber station responds to the notification.

[1084] According to one alternative, the subscriber station is not required to respond even if the subscriber station is interested in participation in the multicast service. Such an alternative is acceptable for example in the case of multicast services, which are of general interest and delivery of which to each subscriber station is not critical, e.g., stock market information updates, streaming video, and other information of similar nature.

[1085] According to another alternative, the subscriber station is always required to respond if the subscriber station is interested in participation in the multicast service. The response comprises e.g., a message send on a reverse channel to the access network. An example of such a message in a communication system in accordance with the IS-2000 standard is a Page Response Message transmitted on a reverse access channel (R-ACH), reverse

enhanced access channel (R-EACH), and reverse common control channel (R-CCCH). Such a response must contain information useful for the next action taken by the access network. Depending on design features of a communication system, such information may indicate whether the subscriber station is interested in joining the multicast service; whether the subscriber station is not interested in joining the multicast service; whether the subscriber station is interested but cannot participate due to not supporting the required configuration, e.g., a data rate.

[1086] The access network waits for response from member subscriber stations before channel assignment. Such an alternative is required for services, requiring the access network to know whether each subscriber station participates. Additionally, the response allows the access network to decide, whether to assign a shared channel or a dedicated channel for the multicast content. When a decision to assign a dedicated channel to each subscriber station is made, the response prevents the access network from assigning a dedicated traffic channel to a non-participating subscriber station.

[1087] As explained above, in one embodiment, each subscriber station that is a member of a multicast group is notified about a start of a multicast call intended for the group by a common message addressed to the member subscriber stations. When a subscriber station that is not a member of the group identified in the common message receives a notification, the subscriber station may ignore the notification and not respond. However, if an AdHoc multicast group formation is supported, all the subscriber station receiving the notification may be required to respond. The term AdHoc multicast group is used herein to mean a multicast group that is not pre-determined, but is created upon initiation of the multicast call. Whether an AdHoc multicast group formation is supported or not, the requirement of response to the common message notification elicits responses from the subscriber stations that received the notification. Because numerous subscriber stations may respond, a method for staggering the response message, e.g., a Page Response Message from the subscriber stations in the group, may be implemented to avoid a collision from a burst of responses.

3NSDOCID: <WO____2004006615A1_I_>

[1088] According to another alternative, the subscriber station is always required to respond, even if the subscriber station is not interested in participation in the multicast service. Such an alternative is required for services, requiring the access network to know with certainty whether each subscriber station participates. Unlike the previous alternative, the present alternative allows the access network to differentiate with certainty between subscriber stations that do not respond due to no interest in the multicast service, and subscriber stations that do not respond due to failure to receive a notification. Thus, the access network may take appropriate action, e.g., repeat the notification. The remaining consideration as described with regards to the previous alternative are applicable.

[1089] It will be understood by one of ordinary skills in the art that the above-described alternatives were treated separately for tutorial purposes only. A communication system will use any alternative appropriate for a multicast service. For example, when a multicast call, delivery of which to each subscriber station is not critical, is to commence, no response may be required from the member subscriber stations. When the same member subscriber stations need to participate in a subsequent multicast call, a response may be required. The indication whether and what response is required by the access network can be indicated to the subscriber stations, e.g., by a signaling contained in the notification message. However, any other means of response indication is contemplated.

Channel Assignment for a Multicast Call Commencement

[1090] As alluded to above, the communication system **100** provides the content over a forward link channel **114** to the member subscriber stations. Consequently, the forward link channel, whether shared among the member subscriber stations or established individually between each member subscriber station and a base station, must be assigned by an entity of the communication system **100** before the multicast service may commence.

[1091] As described above, there are several methods of notification, several methods of response, and several methods of channel assignments. Consequently, several possible combinations of notification, response, and channel assignments are possible as described in the embodiments below.

[1092] As discussed, in one embodiment, the member subscriber stations are notified about the multicast service via a common overhead message or a common page message. Because the multicast service notification is broadcasted in a common message to multiple subscriber station, and not to an individual subscriber station, the entity generating the common message does not need to know the identities of individual member subscriber stations of the multicast group.

[1093] If the member subscriber stations are not required to respond, the channel assignment information for the multicast service traffic channel, e.g., channel identification (Walsh Code in case of a communication system in accordance with IS-2000 standard), data rate, and other assignment information known to one of ordinary skills in the art may be included as part of the notification. Consequently, in case of notification via a common overhead message, the channel assignment information would be part of the overhead message; in case of notification via a common page message, the channel assignment information is part of the MCP. Because the channel assignment information is multicasted and no response is required, the type of channel assigned must be a shared channel. Alternatively, the channel assignment information may be conveyed to the subscriber stations separate from the notification.

[1094] Once the subscriber station processes the message, the interested subscriber station(s) start to monitor the assigned channel to receive multicast service traffic.

[1095] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 9**. At an instant t_1, a sector **S** receives an indication **GROUP_IDx** that a multicast call intended for group with an identifier GROUP_IDx is to start. The indication may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a

source of information (not shown), an other entities. Alternatively, the sector **S** receives identity of the subscriber stations **MS_1** and **MS_2.** The sector **S** then determines the identifier of the multicast group **GROUP_IDx** comprising the subscriber stations **MS_1** and **MS_2,** e.g., by querying a database. As discussed, the source of information may comprise, e.g., a server, another subscriber station, or any other source known to one skilled in the art.

[1096] The sector **S** includes the identifier and the channel assignment information into the overhead message, which in one embodiment comprises a broadcast system parameters message **BSPM.** The sector **S** broadcasts the **BSPM(GROUP_IDx, Channel Assignment Information)** at time t_{2o}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **BSPM(GROUP_IDx, Channel Assignment Information),** process the **BSPM** and take an appropriate action at time t_3, e.g., tune to and start monitoring the physical channel on which the identified multicast call is being transmitted. At time t_4 the content of the multicast service starts to be transmitted on the traffic channel (**Traffic for Group_IDx**). As discussed, the overhead message **BSPM** repeats itself periodically, consequently, if the identifier and the channel assignment information is included in each message, likewise, the identifier and the channel assignment information will be transmitted in the next instance(s) of the overhead message **BSPM.** Only one instance at time t_{2o} is shown.

[1097] Alternatively, the sector **S** includes the identifier and the channel assignment information into a page message, e.g. a general page message (GPM). The sector **S** determines the slot on a paging channel monitored by the member subscriber stations using any of the above-described embodiments. The section then transmits the **GPM(MCP:GROUP_IDx, Channel Assignment Information)** in the slot at time t_{2p}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **GPM(MCP:GROUP_IDx, Channel Assignment Information),** process the **GPM** and take an appropriate action at time t_3, e.g., tune to and start monitoring the physical channel on which the identified multicast call is being transmitted. At time t_4 the content of the multicast service starts to be transmitted on the traffic channel (**Traffic for Group_IDx**).

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[1098] If the member subscriber stations are required to respond prior to channel assignment, upon receiving the multicast service notification in the common message, the interested subscriber stations send a response. Such a response may comprise e.g., a signaling message (a new type of message, e.g., a Multicast Service Join Message as a response to the common overhead message or a Page Response Message as a response to the common page message), indicating the interested subscriber stations' desire to participate in the multicast service.

[1099] Upon receiving the responses, the entity of the access network responsible for the channel assignment may take the number of responses into account in determining the type of channel to assign. In one embodiment, the access network compares the number of responses to a threshold, and assigns the type of channel in accordance with the result of the comparison. If the entity decides to assign a shared channel, the access network sends a common channel assignment message, e.g., a Multicast Channel Assignment Message (MCAM), containing information for the shared multicast service traffic channel. Thus, the MCAM uses a multicast address to assign the shared channel to the interested subscriber stations.

[1100] As has been explained above, the subscriber stations belonging to the group identified by the GROUP_ID are not necessarily assigned the same slot on the paging channel. Consequently, a method enabling efficient method for delivering the multicast call initiation information is required.

[1101] In one embodiment, upon receiving the notification, the subscriber stations are required to monitor the paging channel in a non-slotted mode; consequently, the MCAM may be sent in any paging channel slot.

[1102] In another embodiment, the MCAM is sent on a slot using the same method employed for determining a slot to send a multicast-addressed notification.

[1103] In another embodiment, the common overhead message or the common page message indicates the paging channel slot number, which the subscriber stations are required to monitor for the MCAM.

[1104] In another embodiment, the MCAM is sent on each of the slots monitored by the subscriber stations.

[1105] It will be understood by one of ordinary skills in the art, that the embodiments described were treated separately for tutorial purposes only. A communication system will use an embodiment appropriate for a multicast service. The selection of the embodiment may be specified e.g., in the notification.

[1106] Once the subscriber station processes the message, the subscriber station(s) interested start to monitor the assigned channel to receive multicast service traffic.

[1107] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 10**. At an instant t_1, a sector **S** receives an indication **GROUP_IDx** that a multicast call intended for group with an identifier GROUP_IDx is to start. The indication may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. Alternatively, the sector **S** receives identity of the subscriber stations **MS_1** and **MS_2.** The sector **S** then determines the identifier of the multicast group **GROUP_IDx** comprising the subscriber stations **MS_1** and **MS_2,** e.g., by querying a database. As discussed, the source of information may comprise, e.g., a server, another subscriber station, or any other source known to one skilled in the art.

[1108] The sector **S** includes the identifier into the overhead message, which in one embodiment comprises a broadcast system parameters message **BSPM.** The sector **S** broadcasts the **BSPM(GROUP_IDx)** at time t_{2o}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **BSPM(GROUP_IDx)**, process the **BSPM** and take an appropriate action, e.g., send a response message. As discussed, the overhead message **BSPM** repeats itself periodically, consequently, if the identifier is included in each message, the identifier will be transmitted in the next instance(s) of the overhead message **BSPM.** Only one instance at time t_{2o} is shown.

[1109] Alternatively, the sector **S** includes the identifier into a page message, e.g. a general page message (GPM). The sector **S** then determines

the slot on a paging channel monitored by the member subscriber stations, and transmits the **GPM(MCP:GROUP_IDx)** in the slot at time t_{2p}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **GPM(MCP:GROUP_IDx)**, process the **GPM** and take an appropriate action, e.g., send a response message.

[1110] Regardless of what common message was used for notification, the subscriber stations **MS_1** and **MS_2** send response at time t_3, respective t_4. Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign a shared channel. The sector **S** determines the method of sending the common channel assignment message, e.g., the MCAM, and sends the MCAM containing information for the shared multicast service traffic channel **MCAM(Channel Assignment Information)** at time t_5. The subscriber stations **MS_1** and **MS_2** process the **MCAM** and take an appropriate action, e.g., tune to and start monitoring the physical channel on which the identified multicast call is being transmitted at time t_6. At time t_7 the content of the multicast service starts to be transmitted on the traffic channel (**Traffic for Group_IDx**).

[1111] In another embodiment, if the entity decides to assign a shared channel, the access network sends an Individual Channel Assignment Message (ICAM), containing information for the shared multicast service traffic channel to each responding member subscriber station. In the context of a communication system in accordance with the IS-2000 standard, the ICAM can comprise, e.g., an Extended Channel Assignment Message.

[1112] Such an individual assignment is possible because, although the access network did not necessarily know the identities of the individual subscriber station when sending the notification, upon receiving the responses from subscriber stations the identities were revealed.

[1113] It is noted that because the shared multicast service traffic channel is assigned individually as in a point-to-point call, any method known for a point-to-point traffic channel assignment can be used. Consequently, the issue of when to send the ICAM for each subscriber station is not present because the access network knows when each of the interested subscriber stations will be monitoring the paging channel.

[1114] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 11**. At an instant t_1, a sector **S** receives an indication **GROUP_IDx** that a multicast call intended for group with an identifier GROUP_IDx is to start. The indication may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. Alternatively, the sector **S** receives identity of the subscriber stations **MS_1** and **MS_2**. The sector **S** then determines the identifier of the multicast group **GROUP_IDx** comprising the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. As discussed, the source of information may comprise, e.g., a server, another subscriber station, or any other source known to one skilled in the art.

[1115] The sector **S** includes the identifier into the overhead message, which in one embodiment comprises a broadcast system parameters message **BSPM**. The sector **S** broadcasts the **BSPM(GROUP_IDx)** at time t_{2o}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **BSPM(GROUP_IDx)**, process the **BSPM** and take an appropriate action, e.g., send a response message. As discussed, the overhead message **BSPM** repeats itself periodically, consequently, if the identifier is included in each message, the identifier will be transmitted in the next instance(s) of the overhead message **BSPM**. Only one instance at time t_{2o} is shown.

[1116] Alternatively, the sector **S** includes the identifier into a page message, e.g. a general page message (GPM). The sector **S** then determines the slot on a paging channel monitored by the member subscriber stations, and transmits the **GPM(MCP:GROUP_IDx)** in the slot at time t_{2p}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **GPM(MCP:GROUP_IDx)**, process the **GPM** and take an appropriate action, e.g., send a response message.

[1117] Regardless of what common message was used for notification, the subscriber stations **MS_1** and **MS_2** send response at time t_3, respective t_4. Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign dedicated channels. Because the sector **S** knows the identity of the subscriber stations

MS_1 and **MS_2** from the responses received, the sector **S** determines the slot in which the subscriber stations **MS_1** and **MS_2** will be monitoring the paging channel in accordance with the response. The sector **S** waits until time t_5 for the paging slot monitored by the subscriber station **MS_1**, and then conveys the individual **ICAM(Channel Assignment Information)** to the subscriber station **MS_1.** Similarly, the sector **S** waits until time t_6 for the paging slot monitored by the subscriber station **MS_2**, and then conveys the individual **ICAM(Channel Assignment Information)** subscriber station **MS_2.** The subscriber stations **MS_1** and **MS_2** process the **ICAM** and take an appropriate action, e.g., tune to and start monitoring the physical channel on which the identified multicast call is being transmitted at time t_5 respective t_6. At time t_7 the content of the multicast service starts to be transmitted on the traffic channel (**Traffic for Group_IDx**).

[1118] In another embodiment, if the entity decides to assign a dedicated channel for each responding member subscriber station, the access network sends an individual channel assignment message, containing information for the dedicated multicast service traffic channels to each responding member subscriber station.

[1119] Such an individual assignment is possible because although the access network did not necessarily know the identities of the individual subscriber station when sending the notification, upon receiving the responses from subscriber stations the identities were revealed.

[1120] Because the multicast service traffic channel is assigned individually as in a point-to-point call, any method known for a point-to-point traffic channel assignment can be used. Specifically, the access network knows when each of the interested subscriber stations will be monitoring the paging channel.

[1121] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 12.** At an instant t_1, a sector **S** receives an indication **GROUP_IDx** that a multicast call intended for group with an identifier GROUP_IDx is to start. The indication may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. Alternatively, the sector **S** receives identity of the subscriber stations **MS_1** and **MS_2.** The sector **S** then

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determines the identifier of the multicast group **GROUP_IDx** comprising the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. As discussed, the source of information may comprise, e.g., a server, another subscriber station, or any other source known to one skilled in the art.

[1122] The sector **S** includes the identifier into the overhead message, which in one embodiment comprises a broadcast system parameters message **BSPM.** The sector **S** broadcasts the **BSPM(GROUP_IDx)** at time t_{2o}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **BSPM(GROUP_IDx)**, process the **BSPM** and take an appropriate action, e.g., send a response message. As discussed, the overhead message **BSPM** repeats itself periodically, consequently, if the identifier is included in each message, the identifier will be transmitted in the next instance(s) of the overhead message **BSPM.** Only one instance at time t_{2o} is shown.

[1123] Alternatively, the sector **S** includes the identifier into a page message, e.g. a general page message (GPM). The sector **S** then determines the slot on a paging channel monitored by the member subscriber stations, and transmits the **GPM(MCP:GROUP_IDx)** in the slot at time t_{2p}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **GPM(MCP:GROUP_IDx)**, process the **GPM** and take an appropriate action, e.g., send a response message.

[1124] Regardless of what common message was used for notification, the subscriber stations **MS_1** and **MS_2** send response at time t_3, respective t_4. Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign dedicated channels. Because the sector **S** knows the identity of the subscriber stations **MS_1** and **MS_2** from the responses received, the sector **S** determines the slot in which the subscriber stations **MS_1** and **MS_2** will be monitoring the paging channel in accordance with the response.

[1125] The sector **S** waits until time t_5 for the paging slot monitored by the subscriber station **MS_1**, and then conveys the individual **ICAM(Channel Assignment Information)** to the subscriber station **MS_1.** The subscriber station **MS_1** processes the **ICAM** and take an appropriate action, e.g., tunes to

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and starts monitoring the physical channel on which the identified multicast call is being transmitted at time t_5.

[1126] Similarly, the sector **S** waits until time t_7 for the paging slot monitored by the subscriber station **MS_2**, and then conveys the individual **ICAM(Channel Assignment Information)** subscriber station **MS_2.** The subscriber station **MS_2** processes the **ICAM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call is being transmitted at time t_6.

[1127] At time t_7 the content of the multicast service starts to be transmitted on the dedicated traffic channels (**Traffic for Group_IDx**).

[1128] In another embodiment, if the entity decides to assign a dedicated channel for each responding member subscriber station, the access network sends a common channel assignment message, Multicast Channel Assignment Message (MCAM), containing information for each of the individual multicast service traffic channel. Thus, one MCAM utilizing a multicast address assigns for each interested subscriber stations a dedicated multicast service traffic channel.

[1129] As has been explained above, the subscriber stations belonging to the group identified by the GROUP_ID are not necessarily assigned the same slot on the paging channel. Consequently, a method enabling efficient method for delivering the multicast call initiation information is required.

[1130] In one embodiment, upon receiving the notification, the subscriber stations are required to monitor the paging channel in a non-slotted mode; consequently, the MCAM may be sent in any paging channel slot.

[1131] In another embodiment, the MCAM is sent on a slot using the same method employed for determining a slot to send a multicast-addressed notification.

[1132] In another embodiment, the common overhead message or the common page message indicates the paging channel slot number, which the subscriber stations are required to monitor for the MCAM.

[1133] In another embodiment, the MCAM is sent on each of the slots monitored by the subscriber stations.

[1134] It will be understood by one of ordinary skills in the art, that the embodiments described were treated separately for tutorial purposes only. A communication system will use an embodiment appropriate for a multicast service. The selection of the embodiment may be specified e.g., in the notification.

[1135] Once the subscriber station processes the message, the subscriber station(s) interested start to monitor the assigned channel to receive multicast service traffic.

[1136] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 11**. At an instant t_1, a sector **S** receives an indication **GROUP_IDx** that a multicast call intended for group with an identifier GROUP_IDx is to start. The indication may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. Alternatively, the sector **S** receives identity of the subscriber stations **MS_1** and **MS_2.** The sector **S** then determines the identifier of the multicast group **GROUP_IDx** comprising the subscriber stations **MS_1** and **MS_2,** e.g., by querying a database. As discussed, the source of information may comprise, e.g., a server, another subscriber station, or any other source known to one skilled in the art.

[1137] The sector **S** includes the identifier into the overhead message, which in one embodiment comprises a broadcast system parameters message **BSPM.** The sector **S** broadcasts the **BSPM(GROUP_IDx)** at time t_{2o}. Subscriber stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **BSPM(GROUP_IDx)**, process the **BSPM** and take an appropriate action, e.g., send a response message. As discussed, the overhead message **BSPM** repeats itself periodically, consequently, if the identifier is included in each message, the identifier will be transmitted in the next instance(s) of the overhead message **BSPM.** Only one instance at time t_{2o} is shown.

[1138] Alternatively, the sector **S** includes the identifier into a page message, e.g. a general page message (GPM). The sector **S** then determines the slot on a paging channel monitored by the member subscriber stations, and transmits the **GPM(MCP:GROUP_IDx)** in the slot at time t_{2p}. Subscriber

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stations **MS_1** and **MS_2** that are members of the group with the identifier receive the **GPM(MCP:GROUP_IDx)**, process the **GPM** and take an appropriate action, e.g., send a response message.

[1139] Regardless of what common message was used for notification, the subscriber stations **MS_1** and **MS_2** send response at time t_3, respective t_4. Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign a dedicated channel. The sector **S** determines the method of sending the common channel assignment message, e.g., the MCAM, and sends the MCAM containing information for the dedicated multicast service traffic channel **MCAM(Channel Assignment Information)** at time t_5.

[1140] The subscriber station **MS_1** processes the **MCAM** and take an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call is being transmitted at time t_6.

[1141] Similarly, the subscriber station **MS_2** processes the **ICAM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call is being transmitted at time t_6.

[1142] At time t_7 the content of the multicast service starts to be transmitted on the dedicated traffic channels (**Traffic for Group_IDx**).

[1143] In one embodiment, each member subscriber station is notified about the multicast service via an individual page message. Because the multicast service notification is transmitted via a multiple of individual page messages to multiple subscriber stations, the entity generating the individual page messages needs to know the identities of individual member subscriber stations.

[1144] If the member subscriber stations are not required to respond, the channel assignment information for the multicast service traffic channel, e.g., channel identification (Walsh Code in case of a communication system in accordance with IS-2000 standard), data rate, and other assignment information known to one of ordinary skills in the art may be included as part of the notification. Consequently, in case of notification via the individual page message, the channel assignment information would be part of the individual

page message. Because the channel assignment information is provided in the individual page message, the type of channel assigned may be both a shared channel and a dedicated channel.

[1145] Because the member subscriber stations are not required to respond to the multicast service notification, in case that the entity generating the individual page messages decides to assign a dedicated channel to each member subscriber station, the entity may be allocating dedicated resources for member subscriber station that may not be interested in participating in the multicast service. Therefore, it is desirable to determine, whether a member subscriber station that was assigned a dedicated channel is or is not interested in participating in the multicast service, so that the dedicated channel for the non-participating member subscriber station may be reclaimed, and reused for other service, e.g., a regular point-to-point call. In one embodiment, the access network, after the dedicated channels has been assigned and the multicast service has commenced, determines whether the member subscriber stations are active on the assigned reverse link channel.

[1146] Once the subscriber station processes the message, the subscriber station(s) interested start to monitor the assigned channel to receive multicast service traffic.

[1147] An example of message flow in accordance with the above-described embodiment, in which a shared channel is assigned, is illustrated in **FIG. 14**. At an instant t_1, a sector **S** receives an identity of the subscriber stations **MS_1** and **MS_2 GROUP_IDx**, comprising a group with an identifier GROUP_IDx, for which a multicast call is to start. Alternatively, the sector **S** receives a group identifier GROUP_IDx. The information may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. The sector **S** then determines the identity of the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. The sector **S** then creates an individual MCP containing the identifier GROUP_IDx and a channel assignment information for each subscriber station **MS_1** and **MS_2**, and includes the MCP into a page message, e.g. a general page message (GPM).

[1148] The sector **S** then determines the slots on a paging channel monitored by the member subscriber stations **MS_1** and **MS_2**. At time t_2, in a slot monitored by the member subscriber stations **MS_1**, the sector **S** transmits the **GPM(MCP:GROUP_IDx, Channel Assignment Info)**. Subscriber station **MS_1** receives the **GPM(MCP:GROUP_IDx, Channel Assignment Info)**, processes the **GPM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call is being transmitted.

[1149] At time t_2, in a slot monitored by the member subscriber stations **MS_2**, the sector **S** transmits the **GPM(MCP:GROUP_IDx, Channel Assignment Info)**. Subscriber station **MS_2** receives the **GPM(MCP:GROUP_IDx, Channel Assignment Info)**, processes the **GPM** and take an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call is being transmitted.

[1150] At time t_4 the content of the multicast service starts to be transmitted on the shared traffic channel (**Traffic for Group_IDx**).

[1151] An example of message flow in accordance with the above-described embodiment, in which dedicated channels are assigned, is illustrated in **FIG. 15**. At an instant t_1, a sector **S** receives an identity of the subscriber stations **MS_1** and **MS_2 GROUP ID_x** comprising a group with an identifier GROUP_IDx, for which a multicast call is to start. Alternatively, the sector **S** receives a group identifier GROUP_IDx. The information may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. The sector **S** then determines the identity of the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. The sector **S** then creates an individual MCP containing the identifier GROUP_IDx and a channel assignment information for each subscriber station **MS_1** and **MS_2**, and includes the MCP into a page message, e.g. a general page message (GPM).

[1152] The sector **S** then determines the slots on a paging channel monitored by the member subscriber stations **MS_1** and **MS_2**. At time t_2, in a slot monitored by the member subscriber stations **MS_1**, the sector **S** transmits the **GPM(MCP:GROUP_IDx, Channel Assignment Info for MS_1)**.

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Subscriber station **MS_1** receives the **GPM(GROUP_IDx, Channel Assignment Info for MS_1)**, processes the **GPM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call for the subscriber station **MS_1** is being transmitted (**Traffic for MS_1**) at time t_3.

[1153] At time t_4, in a slot monitored by the member subscriber stations **MS_2**, the sector **S** transmits the **GPM(MCP:GROUP_IDx, Channel Assignment Info for MS_2)**. Subscriber station **MS_2** receives the **GPM(GROUP_IDx, Channel Assignment Info for MS_2)**, processes the **GPM** and take an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call for the subscriber station **MS_2** is being transmitted (**Traffic for MS_2**) at time t_3.

[1154] If the member subscriber stations are required to respond prior to channel assignment, upon receiving the multicast service notification in the individual page messages, the interested subscriber stations sent a response, e.g., a signaling message like a Page Response Message, indicating the interested subscriber stations' desire to participate in the multicast service.

[1155] Upon receiving the responses, the entity of the access network responsible for the channel assignment may take the number of responses into account in determining the type of channel to assign. In one embodiment, the access network compares the number of responses to a threshold, and assigns the type of channel in accordance with the result of the comparison. If the entity decides to assign a shared channel, the access network sends a common channel assignment message, e.g., a Multicast Channel Assignment Message (MCAM), containing information for the shared multicast service traffic channel. Thus, the MCAM uses a multicast address to assign the shared channel to the interested subscriber stations.

[1156] As has been explained above, the subscriber stations belonging to the group identified by the GROUP_ID are not necessarily assigned the same slot on the paging channel. Consequently, a method enabling efficient method for delivering the multicast call initiation information is required.

[1157] In one embodiment, upon receiving the notification, the subscriber stations are required to monitor the paging channel in a non-slotted mode; consequently, the MCAM may be sent in any paging channel slot.

[1158] In another embodiment, the MCAM is sent on a slot using the same method employed for determining a slot to send a multicast-addressed notification.

[1159] In another embodiment, the common overhead message or the common page message indicates the paging channel slot number, which the subscriber stations are required to monitor for the MCAM.

[1160] In another embodiment, the MCAM is sent on each of the slots monitored by the subscriber stations.

[1161] It will be understood by one of ordinary skills in the art, that the embodiments described were treated separately for tutorial purposes only. A communication system will use an embodiment appropriate for a multicast service. The selection of the embodiment may be specified e.g., in the notification.

[1162] Once the subscriber station processes the message, the subscriber station(s) interested start to monitor the assigned channel to receive multicast service traffic.

[1163] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 16**. At an instant t_1, a sector **S** receives an identity of the subscriber stations **MS_1** and **MS_2 GROUP_IDx**, comprising a group with an identifier GROUP_IDx, for which a multicast call is to start. Alternatively, the sector **S** receives a group identifier GROUP_IDx. The information may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. The sector **S** then determines the identity of the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. The sector **S** then creates an individual MCP containing the identifier GROUP_IDx for each subscriber station **MS_1** and **MS_2**, and includes the MCP into a page message, e.g. a general page message (GPM).

[1164] The sector **S** then determines the slots on a paging channel monitored by the member subscriber stations **MS_1** and **MS_2**. At time t_2, in a

slot monitored by the member subscriber stations **MS_1**, the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_1** receives the **GPM(GROUP_IDx)**, and sends a response at time t_3.

[1165] At time t_4, in a slot monitored by the member subscriber stations **MS_2**, the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_2** receives the **GPM(GROUP_IDx)** and sends a response at time t_5.

[1166] Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign shared channel. The sector **S** waits until time t_6 for the paging slot monitored by the subscriber station **MS_1**, and then conveys the individual **ICAM(Channel Assignment Information)** to the subscriber station **MS_1**. The subscriber station **MS_1** processes the **ICAM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call is being transmitted.

[1167] Similarly, the sector **S** waits until time t_7 for the paging slot monitored by the subscriber station **MS_2**, and then conveys the individual **ICAM(Channel Assignment Information)** subscriber station **MS_2**. The subscriber station **MS_2** processes the **ICAM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call is being transmitted.

[1168] At time t_8 the content of the multicast service starts to be transmitted on the traffic channel (**Traffic for Group_IDx**).

[1169] In another embodiment, if the entity decides to assign a shared channel, the access network sends an Individual Channel Assignment Message (ICAM), containing information for the shared multicast service traffic channel to each responding member subscriber station. In the context of a communication system in accordance with the IS-2000 standard, the ICAM can comprise, e.g., an Extended Channel Assignment Message.

[1170] Such an individual assignment is possible because, although the access network did not necessarily know the identities of the individual subscriber station when sending the notification, upon receiving the responses from subscriber stations the identities were revealed.

[1171] It is noted that because the shared multicast service traffic channel is assigned individually as in a point-to-point call, any method known for a point-to-point traffic channel assignment can be used. Consequently, the issue of when to send the ICAM for each subscriber station is not present because the access network knows when each of the interested subscriber stations will be monitoring the paging channel.

[1172] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 17**. At an instant t_1, a sector **S** receives an identity of the subscriber stations **MS_1** and **MS_2 GROUP_IDx**, comprising a group with an identifier GROUP_IDx, for which a multicast call is to start. Alternatively, the sector **S** receives a group identifier GROUP_IDx. The information may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. The sector **S** then determines the identity of the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. The sector **S** then creates an individual MCP containing the identifier GROUP_IDx for each subscriber station **MS_1** and **MS_2**, and includes the MCP into a page message, e.g. a general page message (GPM).

[1173] The sector **S** then determines the slots on a paging channel monitored by the member subscriber stations **MS_1** and **MS_2**. At time t_2, in a slot monitored by the member subscriber stations **MS_1**, the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_1** receives the **GPM(GROUP_IDx)**, and sends a response at time t_3.

[1174] At time t_4, in a slot monitored by the member subscriber stations **MS_2**, the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_2** receives the **GPM(GROUP_IDx)** and sends a response at time t_5.

[1175] Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign shared channels. The sector **S** determines the method of sending the individual channel assignment message, e.g., the ICAM, to each subscriber station **MS_1** and **MS_2**, and sends the ICAMs containing information for the shared multicast service traffic channel **ICAM(Channel Assignment Information)** at time t_6, respective t_7. The subscriber stations **MS_1** and **MS_2** process the ICAMs and

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take an appropriate action, e.g., tune to and start monitoring the physical channel on which the identified multicast call is being transmitted at time t_7. At time t_7 the content of the multicast service starts to be transmitted on the traffic channel (**Traffic for Group_IDx**).

[1176] In another embodiment, if the entity decides to assign a dedicated channels, the access network sends a common channel assignment message, Multicast Channel Assignment Message (MCAM), containing information for the dedicated multicast service traffic channel. Thus, the MCAM uses a multicast address to assign the shared channel to the interested subscriber stations.

[1177] As has been explained above, the subscriber stations belonging to the group identified by the GROUP_ID are not necessarily assigned the same slot on the paging channel. Consequently, a method enabling efficient method for delivering the multicast call initiation information is required.

[1178] In one embodiment, upon receiving the notification, the subscriber stations are required to monitor the paging channel in a non-slotted mode; consequently, the MCAM may be sent in any paging channel slot.

[1179] In another embodiment, the MCAM is sent on a slot using the same method employed for determining a slot to send a multicast-addressed notification.

[1180] In another embodiment, the common overhead message or the common page message indicates the paging channel slot number, which the subscriber stations are required to monitor for the MCAM.

[1181] In another embodiment, the MCAM is sent on each of the slots monitored by the subscriber stations.

[1182] It will be understood by one of ordinary skills in the art, that the embodiments described were treated separately for tutorial purposes only. A communication system will use an embodiment appropriate for a multicast service. The selection of the embodiment may be specified e.g., in the notification.

[1183] Once the subscriber station processes the message, the subscriber station(s) interested start to monitor the assigned channel to receive multicast service traffic.

[1184] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 18**. At an instant t_1, a sector **S** receives an identity of the subscriber stations **MS_1** and **MS_2 GROUP_IDx**, comprising a group with an identifier GROUP_IDx, for which a multicast call is to start. Alternatively, the sector **S** receives a group identifier GROUP_IDx. The information may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. The sector **S** then determines the identity of the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. The sector **S** then creates an individual MCP containing the identifier GROUP_IDx for each subscriber station **MS_1** and **MS_2**, and includes the MCP into a page message, e.g. a general page message (GPM).

[1185] The sector **S** then determines the slots on a paging channel monitored by the member subscriber stations **MS_1** and **MS_2**. At time t_2, in a slot monitored by the member subscriber stations **MS_1,** the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_1** receives the **GPM(GROUP_IDx)**, and sends a response at time t_3.

[1186] At time t_4, in a slot monitored by the member subscriber stations **MS_2,** the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_2** receives the **GPM(GROUP_IDx)** and sends a response at time t_5.

[1187] Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign dedicated channels. The sector **S** determines the method of sending the common channel assignment message, e.g., the MCAM, and sends the MCAM containing information for the dedicated multicast service traffic channel **MCAM(Channel Assignment Information for MS_1, Channel Assignment Information for MS_2)** at time t_6. The subscriber station **MS_1** and **MS_2** process the **MCAM** and take an appropriate action, e.g., tune to and start monitoring the dedicated physical channels **Traffic for MS_1** respective **Traffic for MS_2,** on which the identified multicast call is being transmitted at time t_7 respective t_8.

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[1188] In another embodiment, if the entity decides to assign dedicated channels, the access network sends an individual channel assignment message (Individual Channel Assignment Message - ICAM), containing information for the shared multicast service traffic channel to each responding member subscriber station. In the context of a communication system in accordance with the IS-2000 standard, the ICAM can comprise, e.g., the Extended Channel Assignment Message could be used.

[1189] It is noted that because the shared multicast service traffic channel is assigned individually as in a point-to-point call, any method known for a point-to-point traffic channel assignment can be used. Consequently, the issue of when to send the ICAM for each subscriber station is not present because the access network knows when each of the interested subscriber stations will be monitoring the paging channel.

[1190] An example of message flow in accordance with the above-described embodiment is illustrated in **FIG. 19**. At an instant t_1, a sector **S** receives an identity of the subscriber stations **MS_1** and **MS_2 GROUP_ID_x**, comprising a group with an identifier GROUP_IDx, for which a multicast call is to start. Alternatively, the sector **S** receives a group identifier GROUP_IDx. The information may be provided by another entity of the communication system, e.g., a base station controller, a PSTN, a source of information (not shown), an other entities. The sector **S** then determines the identity of the subscriber stations **MS_1** and **MS_2**, e.g., by querying a database. The sector **S** then creates an individual MCP containing the identifier GROUP_IDx for each subscriber station **MS_1** and **MS_2**, and includes the MCP into a page message, e.g. a general page message (GPM).

[1191] The sector **S** then determines the slots on a paging channel monitored by the member subscriber stations **MS_1** and **MS_2**. At time t_2, in a slot monitored by the member subscriber stations **MS_1**, the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_1** receives the **GPM(GROUP_IDx)**, and sends a response at time t_3.

[1192] At time t_4, in a slot monitored by the member subscriber stations **MS_2**, the sector **S** transmits the **GPM(MCP:GROUP_IDx)**. Subscriber station **MS_2** receives the **GPM(GROUP_IDx)** and sends a response at time t_5.

BNSDOCID: <WO____2004006615A1_I_>

[1193] Upon receiving the responses, the entity of the access network responsible for the channel assignment determines to assign dedicated channel. The sector **S** waits until time t_6 for the paging slot monitored by the subscriber station **MS_1**, and then conveys the individual **ICAM(Channel Assignment Information for MS_1)** to the subscriber station **MS_1.** The subscriber station **MS_1** processes the **ICAM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call for the subscriber station **MS_1** is being transmitted (**Traffic for MS_1**) at time t_7.

[1194] Similarly, the sector **S** waits until time t_8 for the paging slot monitored by the subscriber station **MS_2**, and then conveys the individual **ICAM(Channel Assignment Information for MS_2)** to the subscriber station **MS_2.** The subscriber station **MS_2** processes the **ICAM** and takes an appropriate action, e.g., tunes to and starts monitoring the physical channel on which the identified multicast call for the subscriber station **MS_2** is being transmitted (**Traffic for MS_2**) at time t_9.

[1195] It will be understood by one of ordinary skills in the art that the above-described embodiments were treated separately for tutorial purposes only. A communication system will use any embodiment appropriate for a multicast service. For example, for a multicast call to be delivered to a multicast group whose members are in a coverage area of different sectors, each sector may use different embodiment. Thus, one sector may use multicast notification, require a response, and assign dedicated channel. Another sector may use individual notification, require a response, and assign shared channel. Yet another sector may use multicast notification, require a response, and assign a shared channel to some subscriber stations and a dedicated channel to remaining subscriber stations.

[1196] One skilled in the art will appreciate that although the flowchart diagrams are drawn in sequential order for comprehension, certain steps can be carried out in parallel in an actual implementation.

[1197] Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information,

signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[1198] Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

[1199] The various illustrative logical blocks, modules, and circuits described in connection with the embodiments disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[1200] The steps of a method or algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory,

EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

[1201] The previous description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

[1202] A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyright rights whatsoever.

WHAT IS CLAIMED IS:

CLAIMS

1. A method for a multicast service notification in a communication system, comprising:

determining a multicast group identifier; and

including the multicast group identifier in at least one periodically repeated message on a first channel.

2. The method as claimed in claim 1 wherein said determining a multicast group identifier comprises:

receiving the multicast group identifier from an entity of the communication system.

3. The method as claimed in claim 1 wherein said determining a multicast group identifier comprises:

receiving an identity of subscriber stations belonging to a multicast group; and

determining the multicast group identifier in accordance with the identity of the subscriber stations.

4. The method as claimed in claim 1, further comprising:

receiving an end indicator for a multicast service for subscriber stations identified by the multicast group identifier; and

removing the multicast group identifier from the periodically repeated message on the first channel if the multicast group identifier is included in every periodically repeated message.

5. The method as claimed in claim 1, further comprising:

receiving an end indicator for a multicast service for subscriber stations identified by the multicast group identifier; and

including the end indicator into a signal conveyed over a second channel, if the multicast group identifier is not included in every periodically repeated message.

6. The method as claimed in claim 5, wherein said including the end indicator into a signal conveyed over a second channel comprises:

including the end indicator into a signal conveyed over a channel conveying the multicast service.

7. A method for a multicast service notification of a subscriber station in a communication system, comprising:

monitoring a periodically repeated message on a channel; and

decoding the periodically repeated message to determine if a multicast service notification was included in the periodically repeated message.

8. The method as claimed in claim 7, further comprising:

receiving a channel conveying the multicast service.

9. The method as claimed in claim 8, further comprising:

receiving an end indicator over the channel conveying the multicast service; and

discontinuing reception of the channel conveying the multicast service.

10. The method as claimed in claim 8, further comprising:

receiving an end indicator over a second channel; and

discontinuing reception of the channel conveying the multicast service.

11. An apparatus for a multicast service notification in a communication system, comprising:

a processor; and

a storage medium coupled to the processor and containing a set of instructions executable by the processor to:

determine a multicast group identifier; and

include the multicast group identifier in at least one periodically repeated message on a first channel.

12. The apparatus as claimed in claim 11 wherein said processor determines a multicast group identifier by processing a set of instructions to:

receive the multicast group identifier from an entity of the communication system.

13. The apparatus as claimed in claim 11 wherein said processor determines a multicast group identifier by processing a set of instructions to:

receive an identity of subscriber stations belonging to a multicast group; and

determine the multicast group identifier in accordance with the identity of the subscriber stations.

14. The apparatus as claimed in claim 11 wherein said processor is further configured to:

receive an end indicator for a multicast service for subscriber stations identified by the multicast group identifier; and

remove the multicast group identifier from the periodically repeated message on the first channel if the multicast group identifier is included in every periodically repeated message.

15. The apparatus as claimed in claim 11 wherein said processor is further configured to:

receive an end indicator for a multicast service for subscriber stations identified by the multicast group identifier; and

include the end indicator into a signal conveyed over a second channel, if the multicast group identifier is not included in every periodically repeated message.

16. The apparatus as claimed in claim 15, wherein said processor includes the end indicator into a signal conveyed over a second channel by processing a set of instructions to:

include the end indicator into a signal conveyed over a channel conveying the multicast service.

17. The apparatus as claimed in claim 17, wherein said processor and said storage medium are disposed in a base station.

18. The apparatus as claimed in claim 17 wherein the multicast group identifier is received from an entity of the communication system different from the base station.

19. A apparatus for a multicast service notification in a communication system, comprising:

a subscriber station configured to:

monitor a periodically repeated message on a channel; and

decode the periodically repeated message to determine if a multicast service notification was included in the periodically repeated message.

20. The apparatus as claimed in claim 19 wherein said subscriber station is further configured to:

receive a channel conveying the multicast service.

21. The apparatus as claimed in claim 20 wherein said subscriber station is further configured to:

receive an end indicator over the channel conveying the multicast service; and

discontinue reception of the channel conveying the multicast service

22. The apparatus as claimed in claim 19 wherein said subscriber station is further configured to:

receive an end indicator over a second channel; and

3NSDOCID: <WO_____2004006615A1_I_>

discontinue reception of the channel conveying the multicast service

23. A method for a multicast service notification in a communication system, comprising:

determining identity of subscriber stations belonging to a multicast group;

determining a slot of a channel in accordance with the identity of a subscriber station; and

transmitting a multicast service notification in the slot on a channel.

24. The method as claimed in claim 23 wherein said determining identity of subscriber station belonging to a multicast group comprises:

receiving the identity of subscriber station from an entity of the communication system.

25. The method as claimed in claim 23 wherein said determining identity of subscriber station belonging to a multicast group comprises:

receiving a multicast group identifier from an entity of the communication system; and

determining identity of subscriber station in accordance with the multicast group identifier.

26. A method for a multicast service notification in a communication system, comprising:

monitoring a slot of a channel; and

decoding a message conveyed in the slot to determine if a multicast service notification was included in the message.

27. The method as claimed in claim 26 wherein monitoring a slot of a channel comprises:

determining the slot in accordance with the identity of a subscriber station.

28. An apparatus for a multicast service notification in a communication system, comprising:

a processor; and

a storage medium coupled to the processor and containing a set of instructions executable by the processor to:

determine identity of subscriber stations belonging to a multicast group;

determine a slot of a channel, the slot corresponding to the identity of a subscriber station; and

transmit a multicast service notification in the slot on a channel.

29. An apparatus for a multicast service notification of a subscriber station in a communication system, comprising:

a subscriber station configured to:

monitoring a slot of a channel; and

decoding a message conveyed in the slot to determine if a multicast service notification was included in the message.

30. A method for a multicast service notification in a communication system, comprising:

including an indicator into a pre-determined slot on a first channel; and

including a multicast service notification into a message conveyed in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator.

31. The method as claimed in claim 30 wherein said including the indicator into a pre-determined slot comprises:

determining a broadcast paging cycle; and

including the indicator into an n-th slot of each broadcast paging cycle.

32. The method as claimed in claim 31 wherein said including the indicator into an n-th slot of each broadcast paging cycle comprises:

including the indicator into the first slot of each broadcast paging cycle.

3NSDOCID: <WO_____2004006615A1_I_>

33. The method as claimed in claim 30 wherein said including a multicast service notification into a message conveyed in a slot on a second channel comprises:

including the multicast service notification in the slot on the second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

34. A method for a multicast service notification of a subscriber station in a communication system, comprising:

decoding an indicator from a pre-determined slot on a first channel; and

decoding a multicast service notification in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator.

35. The method as claimed in claim 34 wherein decoding an indicator from a pre-determined slot on a first channel comprises:

determining a broadcast paging cycle; and

decoding the indicator in an n-th slot of each broadcast paging cycle.

36. The method as claimed in claim 35 wherein said decoding an indicator in an n-th slot of each broadcast paging cycle comprises:

decoding the indicator in a first slot of each broadcast paging cycle

37. The method as claimed in claim 34 wherein said decoding a multicast service notification in a slot on a second channel comprises:

decoding the multicast service notification in the slot on the second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

38. An apparatus for a multicast service notification in a communication system, comprising:

a processor; and

BNSDOCID: <WO____2004006615A1_I_>

a storage medium coupled to the processor and containing a set of instructions executable by the processor to:

include an indicator into a pre-determined slot on a first channel; and

include a multicast service notification into a message conveyed in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator.

39. The apparatus as claimed in claim 38 wherein said processor includes an indicator into a pre-determined slot by executing a set of instructions to:

determine a broadcast paging cycle; and

include the indicator into an n-th slot of each broadcast paging cycle.

40. The apparatus as claimed in claim 39 wherein said processor includes the indicator into an n-th slot of each broadcast paging cycle by executing a set of instructions to:

include the indicator into the first slot of each broadcast paging cycle.

41. The apparatus as claimed in claim 38 wherein said processor includes a multicast service notification into a message conveyed in a slot on a second channel by executing a set of instructions to

include the multicast service notification in the slot on the second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

42. The apparatus as claimed in claim 38 wherein said processor and said storage medium are disposed in a base station.

43. A apparatus for a multicast service notification of a subscriber station in a communication system, comprising:

a subscriber station configured to:

decode an indicator from a pre-determined slot on a first channel; and

decode a multicast service notification in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator.

44. The apparatus as claimed in claim 43 wherein said subscriber station decodes an indicator from a pre-determined slot on a first channel by being configured to:

determine a broadcast paging cycle; and

decode the indicator in an n-th slot of each broadcast paging cycle.

45. The apparatus as claimed in claim 44 wherein said subscriber station decodes the indicator in an n-th slot of each broadcast paging cycle by being configured to:

decode the indicator in a first slot of each broadcast paging cycle

46. The apparatus as claimed in claim 43 wherein said subscriber station decodes a multicast service notification in a slot on a second channel by being configured to:

decode the multicast service notification in the slot on the second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

47. A method for a multicast service notification in a communication system, comprising:

including an indicator into a first slot on a first channel; and

including a multicast service notification into a message conveyed in a second slot on a second channel, the second slot corresponding to the first slot, if a multicast service notification was indicated by the indicator.

48. The method as claimed in claim 47 wherein said including an indicator into a first slot comprises:

determining a multicast paging cycle; and

BNSDOCID: <WO____2004006615A1_I_>

determining the first slot in accordance with the multicast paging cycle and a multicast group identifier.

49. The method as claimed in claim 48 wherein said determining the first slot in accordance with the multicast paging cycle and a multicast group identifier comprises:

inputting the multicast paging cycle and the multicast group identifier into a hashing function; and

setting the first slot to a value outputted by the hashing function.

50. The method as claimed in claim 47 wherein said including a multicast service notification into a message conveyed in a second slot on a second channel comprises:

including the multicast service notification into the message conveyed in the second slot on the second channel, the second slot being offset from the first slot by a pre-determined interval.

51. The method as claimed in claim 50 wherein said second slot being offset from the first slot by a pre-determined interval comprises:

second slot being offset from the first slot by 100 milliseconds.

52. A method for a multicast service notification of a subscriber station in a communication system, comprising:

decoding an indicator from a first slot on a first channel; and

decoding a multicast service notification in a second slot on a second channel, the second slot corresponding to the first slot, if a multicast service notification was indicated by the indicator.

53. The method as claimed in claim 52 wherein said decoding an indicator from a first slot on a first channel comprises:

determining a multicast paging cycle; and

determining the first slot in accordance with the multicast paging cycle and a multicast group identifier.

54. The method as claimed in claim 53 wherein said determining the first slot in accordance with the multicast paging cycle and a multicast group identifier comprises:

inputting the multicast paging cycle and a multicast group identifier into a hashing function; and

setting the first slot to a value outputted by the hashing function.

55. The method as claimed in claim 52 wherein said decoding a multicast service notification in a second slot on a second channel, the second slot corresponding to the first slot comprises:

decoding the multicast service notification in the second slot, the second slot being offset from the first slot by a pre-determined interval.

56. The method as claimed in claim 55 wherein said second slot being offset from the first slot by a pre-determined interval comprises:

second slot being offset from the first slot by 100 miliseconds.

57. An apparatus for a multicast service notification in a communication system, comprising:

a processor; and

a storage medium coupled to the processor and containing a set of instructions executable by the processor to:

include an indicator into a first slot on a first channel; and

include a multicast service notification into a message conveyed in a second slot on a second channel, the second slot corresponding to the first slot, if a multicast service notification was indicated by the indicator.

58. The apparatus as claimed in claim 57 wherein said processor includes an indicator into a first slot by executing a set of instructions to:

determine a multicast paging cycle; and

determine the first slot in accordance with the multicast paging cycle and a multicast group identifier.

59. The apparatus as claimed in claim 58 wherein said processor determines the first slot in accordance with the multicast paging cycle and a multicast group identifier by executing a set of instructions to:

input the multicast paging cycle and a multicast group identifier into a hashing function; and

set the first slot to a value outputted by the hashing function.

60. The apparatus as claimed in claim 57 wherein said processor includes a multicast service notification into a message conveyed in a second slot on a second channel by executing a set of instructions to:

include a multicast service notification into a message conveyed in a second slot on a second channel, the second slot being offset from the first slot by a pre-determined interval.

61. The apparatus as claimed in claim 60 wherein said second slot is offset from the first slot by 100 miliseconds.

62. The apparatus as claimed in claim 57, wherein said processor and said storage medium are disposed in a base station.

63. Â apparatus for a multicast service notification of a subscriber station in a communication system, comprising:

a subscriber station configured to:

decode an indicator from a first slot on a first channel; and

decode a multicast service notification in a second slot on a second channel, the second slot corresponding to the first slot, if a multicast service notification was indicated by the indicator.

64. The apparatus as claimed in claim 63 wherein said subscriber station decodes an indicator from a first slot on a first channel by being configured to:

determine a multicast paging cycle; and

determine the first slot in accordance with the multicast paging cycle and a multicast group identifier.

65. The apparatus as claimed in claim 64 wherein said subscriber station determines the first slot in accordance with the multicast paging cycle and a multicast group identifier by being configured to:

input the multicast paging cycle and a multicast group identifier into a hashing function; and

set the first slot to a value outputted by the hashing function.

66. The apparatus as claimed in claim 63 wherein said subscriber station decodes a multicast service notification in a second slot on a second channel, the second slot corresponding to the first slot by being configured to:

decode a multicast service notification in a second slot, the second slot being offset from the first slot by a pre-determined interval.

67. The apparatus as claimed in claim 66 wherein said second slot being offset from the first slot by a pre-determined interval comprises:

second slot being offset from the first slot by 100 miliseconds.

68. A method for a multicast service notification in a communication system, comprising:

establishing a link layer protocol between a subscriber station belonging to a multicast group and an entity of an access network; and

conveying the multicast service notification over the link layer protocol.

69. The method as claimed in claim 68 wherein said establishing a link layer protocol comprises:

determining identity of subscriber stations belonging to the multicast group;

determining a slot of a channel in accordance with the identity of a subscriber station; and

including a link layer protocol establishment request in the slot on the channel.

70. The method as claimed in claim 69 wherein said determining identity of subscriber-stations belonging to a multicast group comprises:

receiving the identity of subscriber stations from an entity of the communication system.

71. The method as claimed in claim 69 wherein said determining identity of subscriber stations belonging to a multicast group comprises:

receiving a multicast group identifier from an entity of the communication system; and

determining identity of subscriber station in accordance with the multicast group identifier.

72. A method for a multicast service notification in a communication system, comprising:

establishing a link layer protocol between a subscriber station belonging to a multicast group and an entity of the access network; and

receiving, at the subscriber station belonging to the multicast group, the multicast service notification over the link layer protocol.

73. The method claimed in claim 72 wherein said establishing a link layer protocol comprises:

monitoring, by the subscriber station, a slot of a channel; and

establishing a link layer protocol between the subscriber station and the entity of the access network if a message conveyed in the slot comprises a link layer protocol establishment request.

74. The method as claimed in claim 68 wherein said establishing a link layer protocol comprises:

including an indicator into a pre-determined slot on a first channel; and

including a link layer protocol establishment request into a message conveyed in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator.

75. The method as claimed in claim 74 wherein said including an indicator into a pre-determined slot comprises:

determining a broadcast paging cycle; and

including an indicator into an n-th slot of each broadcast paging cycle.

76. The method as claimed in claim 75 wherein including an indicator into an n-th slot of each broadcast paging cycle comprises:

including the indicator into a first slot of each broadcast paging cycle.

77. The method as claimed in claim 74 wherein said including a link layer protocol establishment request in a slot on a second channel comprises:

including the link layer protocol establishment request in the slot on the second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

78. The method as claimed in claim 72 wherein said establishing a link layer protocol comprises:

decoding an indicator from a pre-determined slot on a first channel; and

decoding a link layer protocol establishment request in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator.

79. The method as claimed in claim 78 wherein decoding an indicator from a pre-determined slot on a first channel comprises:

determining a broadcast paging cycle; and

decoding an indicator in an n-th slot of each broadcast paging cycle.

80. The method as claimed in claim 79 wherein said decoding an indicator in an n-th slot of each broadcast paging cycle comprises:

decoding an indicator in a first slot of each broadcast paging cycle

81. The method as claimed in claim 78 wherein said decoding a link layer protocol establishment request in a slot on a second channel comprises:

decoding a multicast service notification in a slot on a second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

82. The method as claimed in claim 68 wherein said establishing a link layer protocol comprises:

including an indicator into a first slot on a first channel; and

including a link layer protocol establishment request into a message conveyed in a second slot on a second channel, the second slot corresponding to the first slot, if a multicast service notification was indicated by the indicator.

83. The method as claimed in claim 82 wherein said including an indicator into a first slot comprises:

determining a multicast paging cycle; and

determining the first slot in accordance with the multicast paging cycle and a multicast group identifier.

84. The method as claimed in claim 83 wherein said determining the first slot in accordance with the multicast paging cycle and a multicast group identifier comprises:

inputting the multicast paging cycle and a multicast group identifier into a hashing function; and

setting the first slot to a value outputted by the hashing function.

85. The method as claimed in claim 82 wherein said including a link layer protocol establishment request into a message conveyed in a second slot on a second channel comprises:

including a link layer protocol establishment request into a message conveyed in a second slot on a second channel, the second slot being offset from the first slot by a pre-determined interval.

86. The method as claimed in claim 72 wherein said establishing a link layer protocol comprises:

decoding an indicator from a first slot on a first channel; and

decoding a link layer protocol establishment request in a second slot on a second channel, the second slot corresponding to the first slot, if a multicast service notification was indicated by the indicator.

87. The method as claimed in claim 86 wherein said decoding an indicator from a first slot on a first channel comprises:

determining a multicast paging cycle; and

determining the first slot in accordance with the multicast paging cycle and a multicast group identifier.

88. The method as claimed in claim 86 wherein said decoding a link layer protocol establishment request in a second slot on a second channel, the second slot corresponding to the first slot comprises:

decoding a multicast service notification in a second slot, the second slot being offset from the first slot by a pre-determined interval.

89. An apparatus for a multicast service notification in a communication system, comprising:

a processor; and

a storage medium coupled to the processor and containing a set of instructions executable by the processor to:

establish a link layer protocol between a subscriber station belonging to a multicast group and an entity of the access network; and

convey the multicast service notification over the link layer protocol.

90. The apparatus as claimed in claim 89 wherein said processor establishes a link layer protocol by executing a set of instructions to:

determine an identity of subscriber stations belonging to the multicast group;

determine a slot of a channel, the slot corresponding to the identity of a subscriber station; and

include a link layer protocol establishment request in the slot on a channel.

91. The apparatus as claimed in claim 90 wherein said processor determines identity of subscriber stations belonging to a multicast group by executing a set of instructions to:

receive the identity of subscriber stations from an entity of the communication system.

92. The apparatus as claimed in claim 90 wherein said processor determines identity of subscriber stations belonging to a multicast group by executing a set of instructions to:

receive a multicast group identifier from an entity of the communication system; and

determine the identity of subscriber station in accordance with the multicast group identifier.

93. A apparatus for a multicast service notification in a communication system, comprising:

a subscriber station configured to:

establish a link layer protocol between a subscriber station belonging to a multicast group and an entity of an access network; and

receive the multicast service notification over the link layer protocol.

94. The apparatus claimed in claim 93 wherein said subscriber station establishes link layer protocol by being configured to:

monitor a slot of a channel; and

establish a link layer protocol between the subscriber station and the entity of the access network if a message conveyed in the slot comprises a link layer protocol establishment request.

95. The apparatus as claimed in claim 89 wherein said processor establishes a link layer protocol by executing a set of instruction to:

include an indicator into a pre-determined slot on a first channel; and

include a link layer protocol establishment request into a message conveyed in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a multicast service notification was indicated by the indicator.

96. The apparatus as claimed in claim 95 wherein said processor includes an indicator into a pre-determined slot by executing a set of instructions to:

determine a broadcast paging cycle; and

include an indicator into an n-th slot of each broadcast paging cycle.

97. The apparatus as claimed in claim 93 wherein said processor includes an indicator into an n-th slot of each broadcast paging cycle by executing a set of instructions to:

include an indicator into the first slot of each broadcast paging cycle.

98. The apparatus as claimed in claim 95 wherein said processor includes a link layer protocol establishment request into a message conveyed in a slot on a second channel by executing a set of instructions to

include a multicast service notification in a slot on a second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

99. The apparatus claimed in claim 93 wherein said subscriber station establishes link layer protocol by being configured to:

decode an indicator from a pre-determined slot on a first channel; and

BNSDOCID: <WO____2004006615A1_I_>

decode a link layer protocol establishment request in a slot on a second channel, the slot corresponding to the pre-determined slot on the first channel, if a link layer protocol establishment request was indicated by the indicator.

100. The apparatus as claimed in claim 99 wherein said subscriber station decodes an indicator from a pre-determined slot on a first channel by being configured to:

determine a broadcast paging cycle; and

decode an indicator in an n-th slot of each broadcast paging cycle.

101. The apparatus as claimed in claim 100 wherein said subscriber station decodes an indicator in an n-th slot of each broadcast paging cycle by being configured to:

decode an indicator in a first slot of each broadcast paging cycle

102. The apparatus as claimed in claim 99 wherein said subscriber station decodes a link layer protocol establishment request in a slot on a second channel by being configured to:

decode a link layer protocol establishment request in a slot on a second channel, the slot being offset from the pre-determined slot on the first channel by a pre-determined interval.

103. The apparatus as claimed in claim 89 wherein said processor establishes a link layer protocol by executing a set of instruction to:

include an indicator into a first slot on a first channel; and

include a link layer protocol establishment request into a message conveyed in a second slot on a second channel, the second slot corresponding to the first slot, if a link layer protocol establishment request was indicated by the indicator.

104. The apparatus as claimed in claim 103 wherein said processor includes an indicator into a first slot by executing a set of instructions to:

determine a multicast paging cycle; and

determine the first slot in accordance with the multicast paging cycle and a multicast group identifier.

105. The apparatus as claimed in claim 104 wherein said processor determines the first slot in accordance with the multicast paging cycle and a multicast group identifier by executing a set of instructions to:

input the multicast paging cycle and a multicast group identifier into a hashing function; and

set the first slot to a value outputted by the hashing function.

106. The apparatus as claimed in claim 103 wherein said processor includes a link layer protocol establishment request into a message conveyed in a second slot on a second channel by executing a set of instructions to:

include a link layer protocol establishment request into a message conveyed in a second slot on a second channel, the second slot being offset from the first slot by a pre-determined interval.

107. The apparatus as claimed in claim 106 wherein said second slot is offset from the first slot by 100 miliseconds.

108. The apparatus as claimed in claim 99, wherein said processor and said storage medium are disposed in a base station.

109. The apparatus claimed in claim 93 wherein said subscriber station establishes link layer protocol by being configured to:

decode an indicator from a first slot on a first channel; and

decode a link layer protocol establishment request in a second slot on a second channel, the second slot corresponding to the first slot, if a link layer protocol establishment request was indicated by the indicator.

110. The apparatus as claimed in claim 109 wherein said subscriber station decodes an indicator from a first slot on a first channel by being configured to:

determine a multicast paging cycle; and

determine the first slot in accordance with the multicast paging cycle and a multicast group identifier.

111. The apparatus as claimed in claim 110 wherein said subscriber station determines the first slot in accordance with the multicast paging cycle and a multicast group identifier by being configured to:

input the multicast paging cycle and a multicast group identifier into a hashing function; and

set the first slot to a value outputted by the hashing function.

112. The apparatus as claimed in claim 109 wherein said subscriber station decodes a link layer protocol establishment request in a second slot on a second channel, the second slot corresponding to the first slot by being configured to:

decode a link layer protocol establishment request in a second slot, the second slot being offset from the first slot by a pre-determined interval.

113. The apparatus as claimed in claim 112 wherein said second slot being offset from the first slot by a pre-determined interval comprises:
second slot being offset from the first slot by 100 miliseconds.

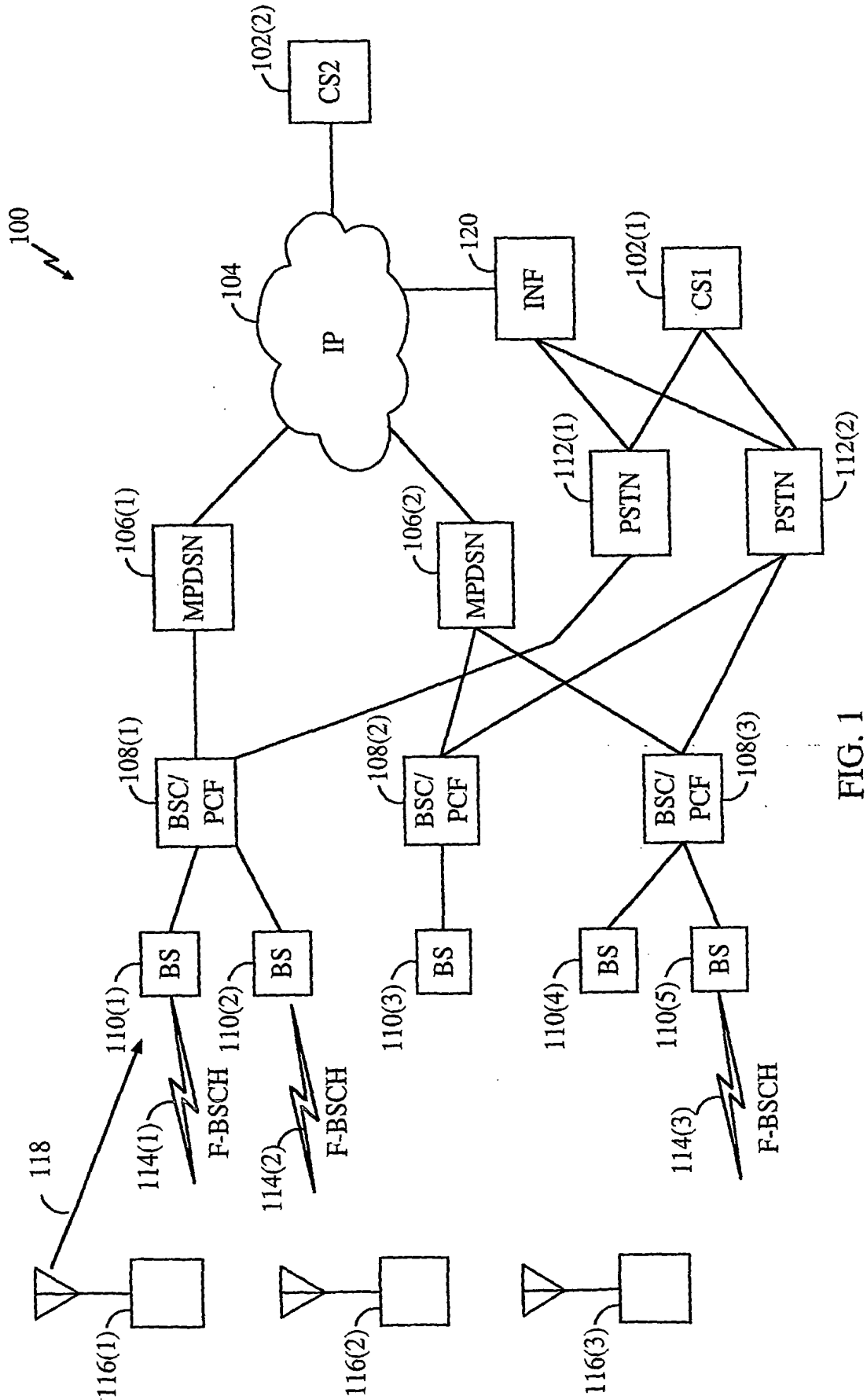

FIG. 1

BNSDOCID: <WO_____2004006615A1_I_>

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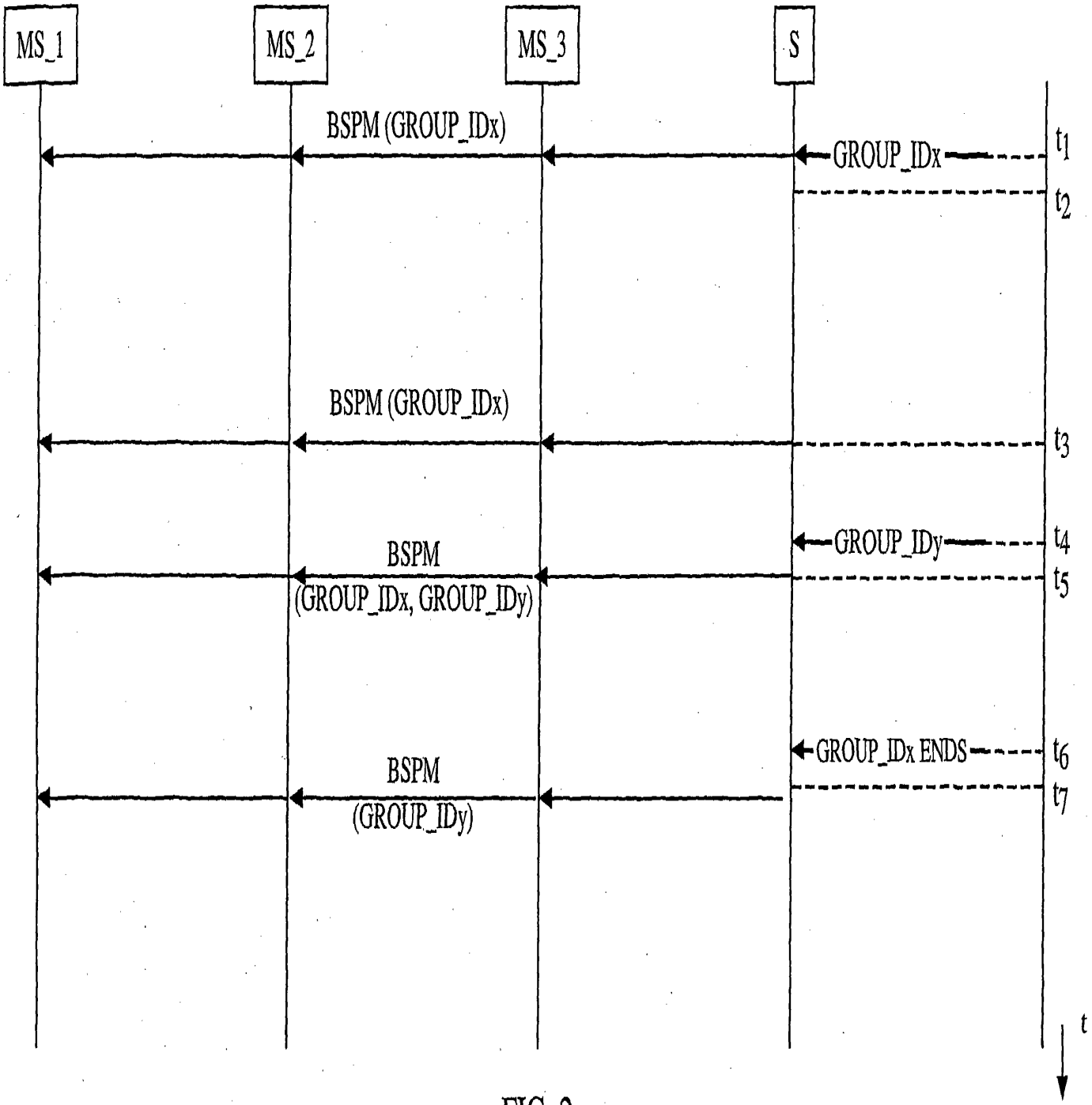

FIG. 2

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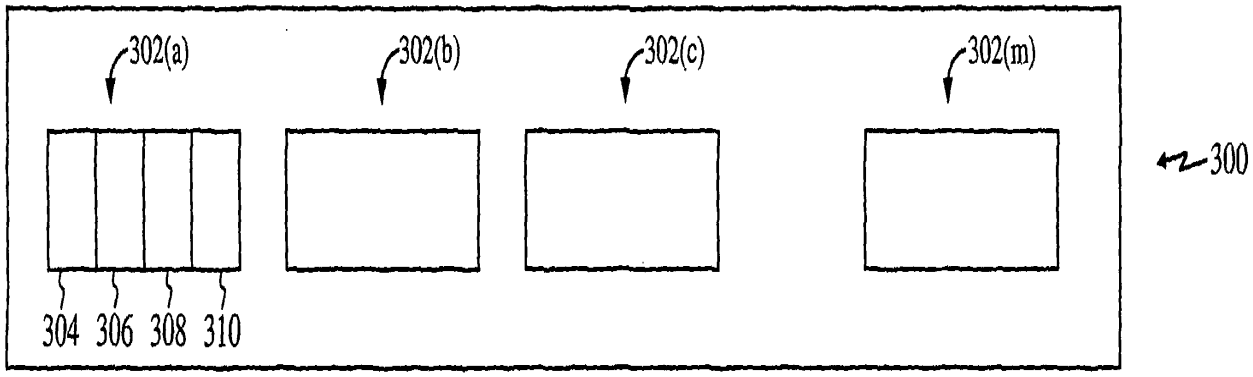

FIG. 3

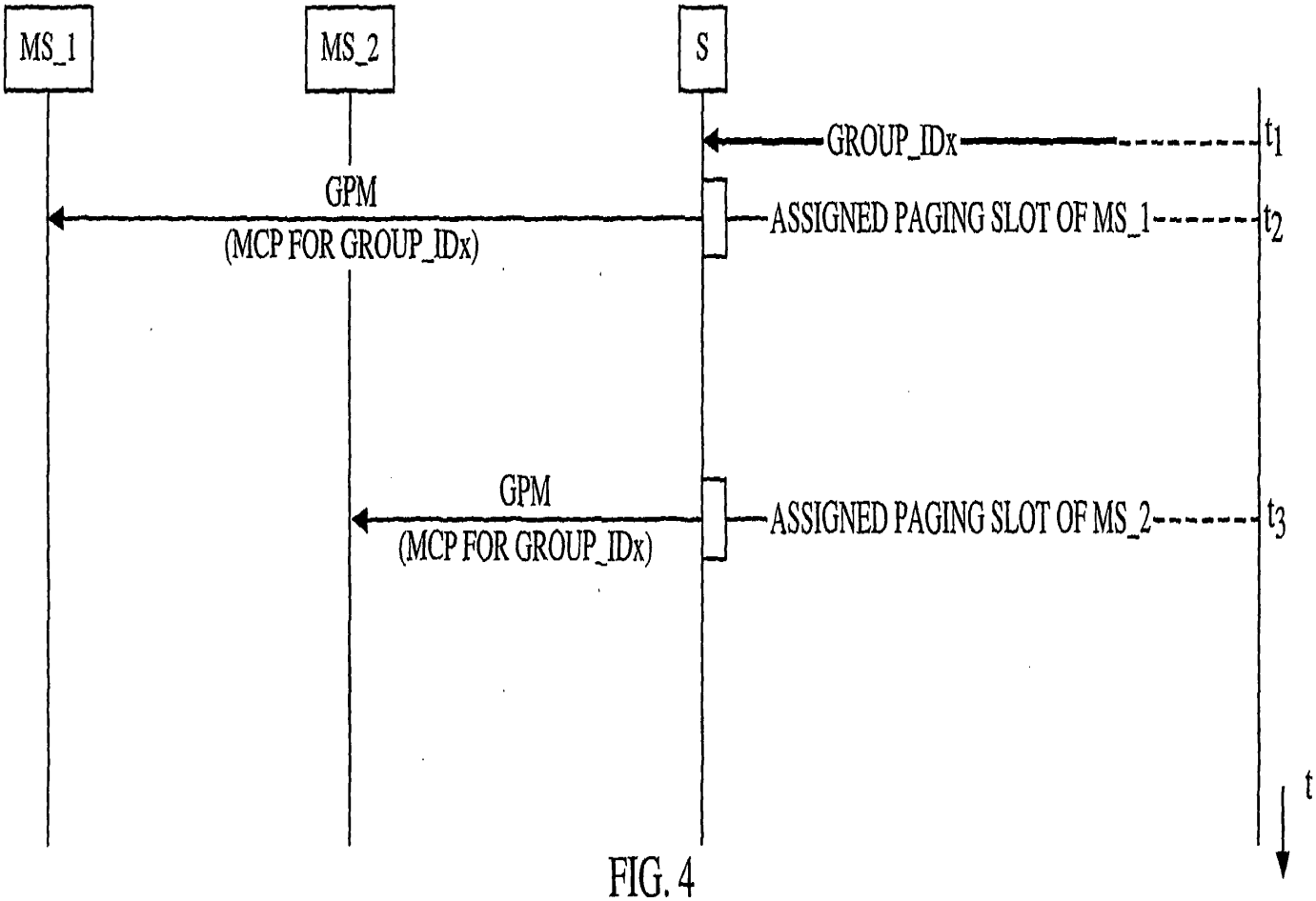

FIG. 4

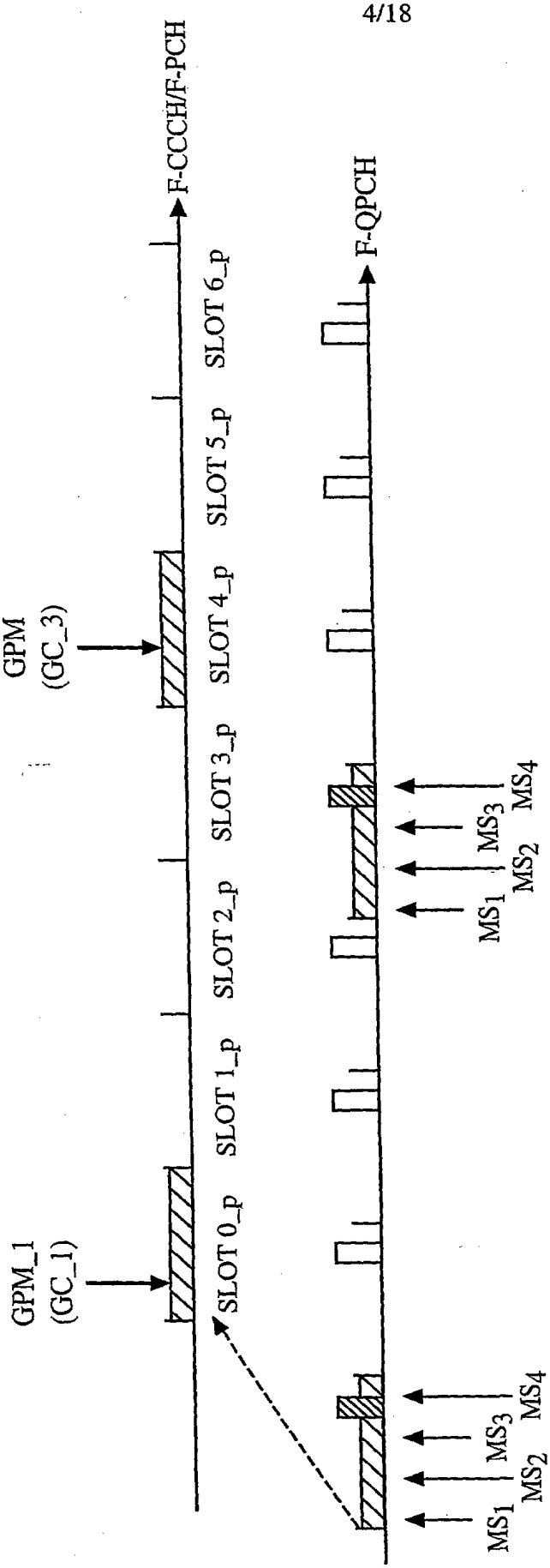

FIG. 5

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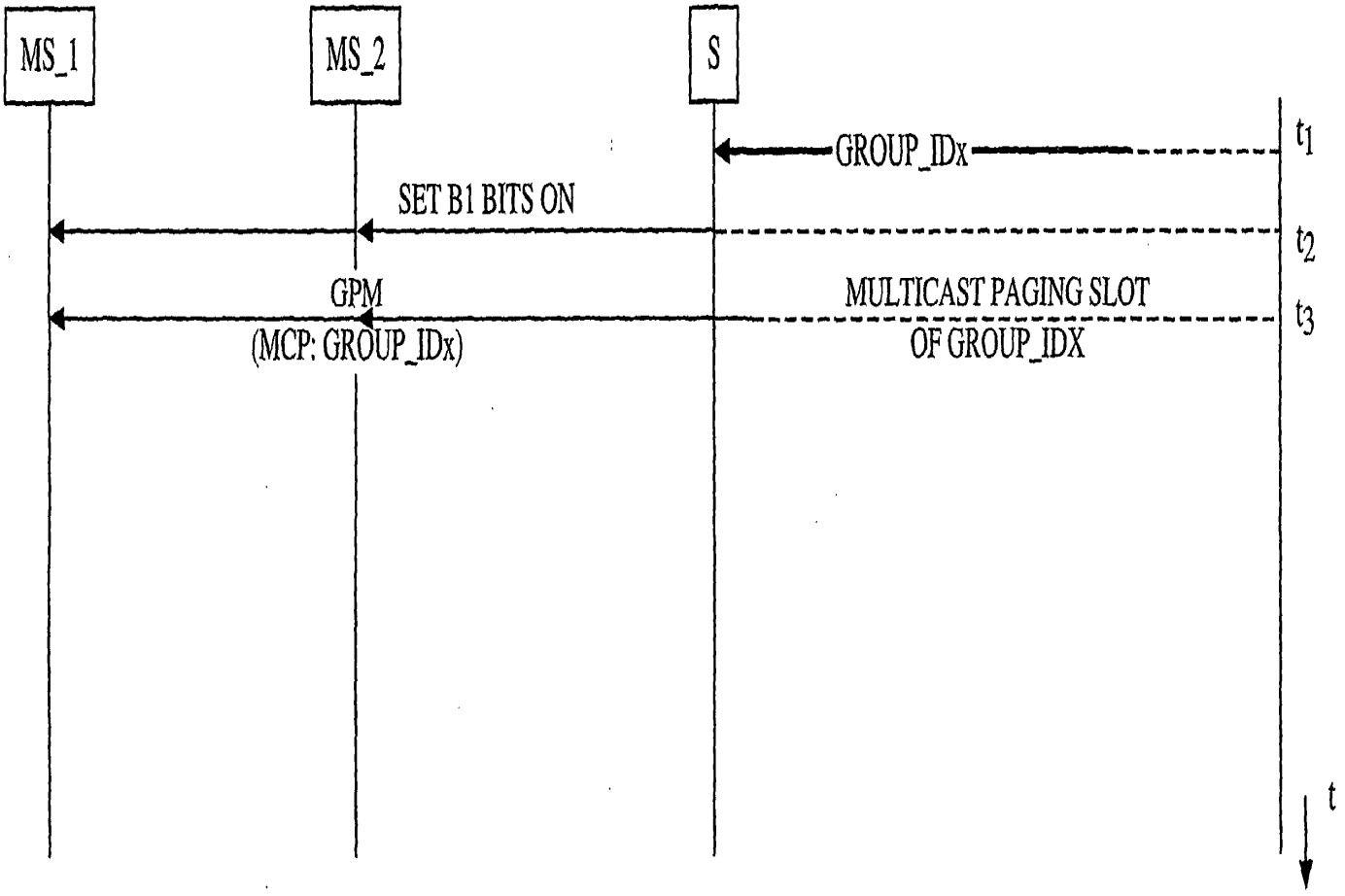

FIG. 6

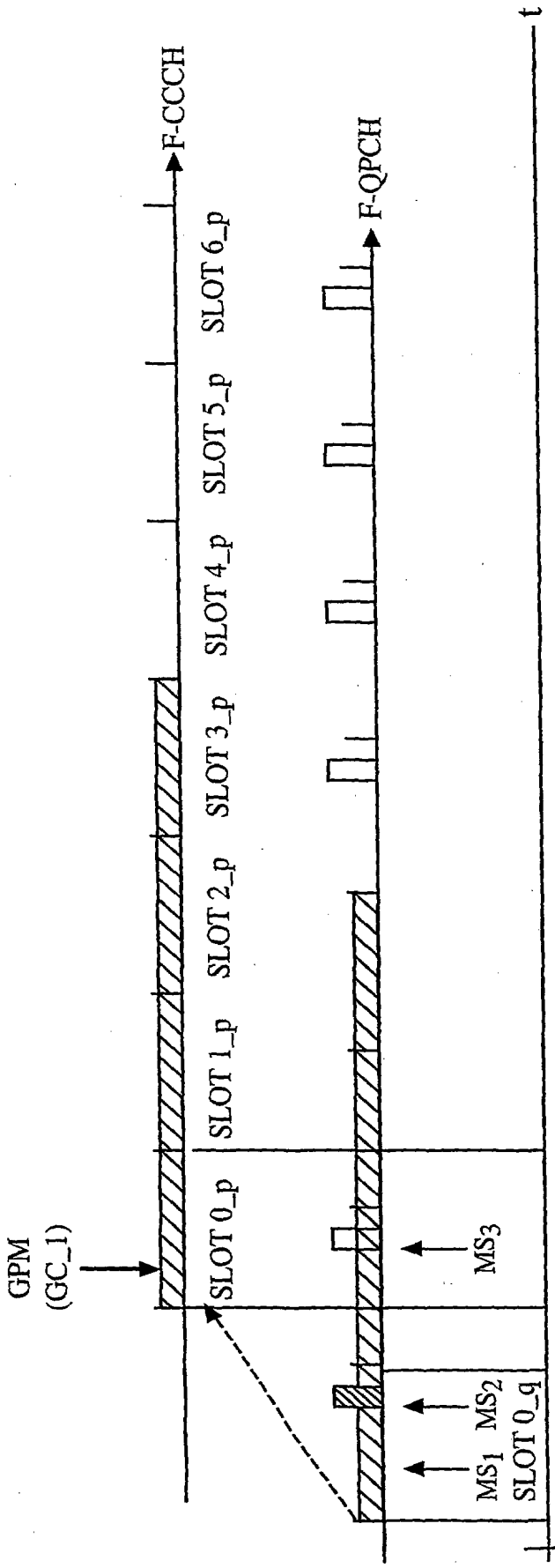
t
F-CCCH
F-QPCH
SLOT 6_p
SLOT 5_p
SLOT 4_p
SLOT 3_p
SLOT 2_p
SLOT 1_p
SLOT 0_p
GPM
(GC_1)
MS3
MS2
MS1
SLOT 0_q
t3
t2
t1

FIG. 7

BNSDOCID: <WO_____2004006615A1_1_>

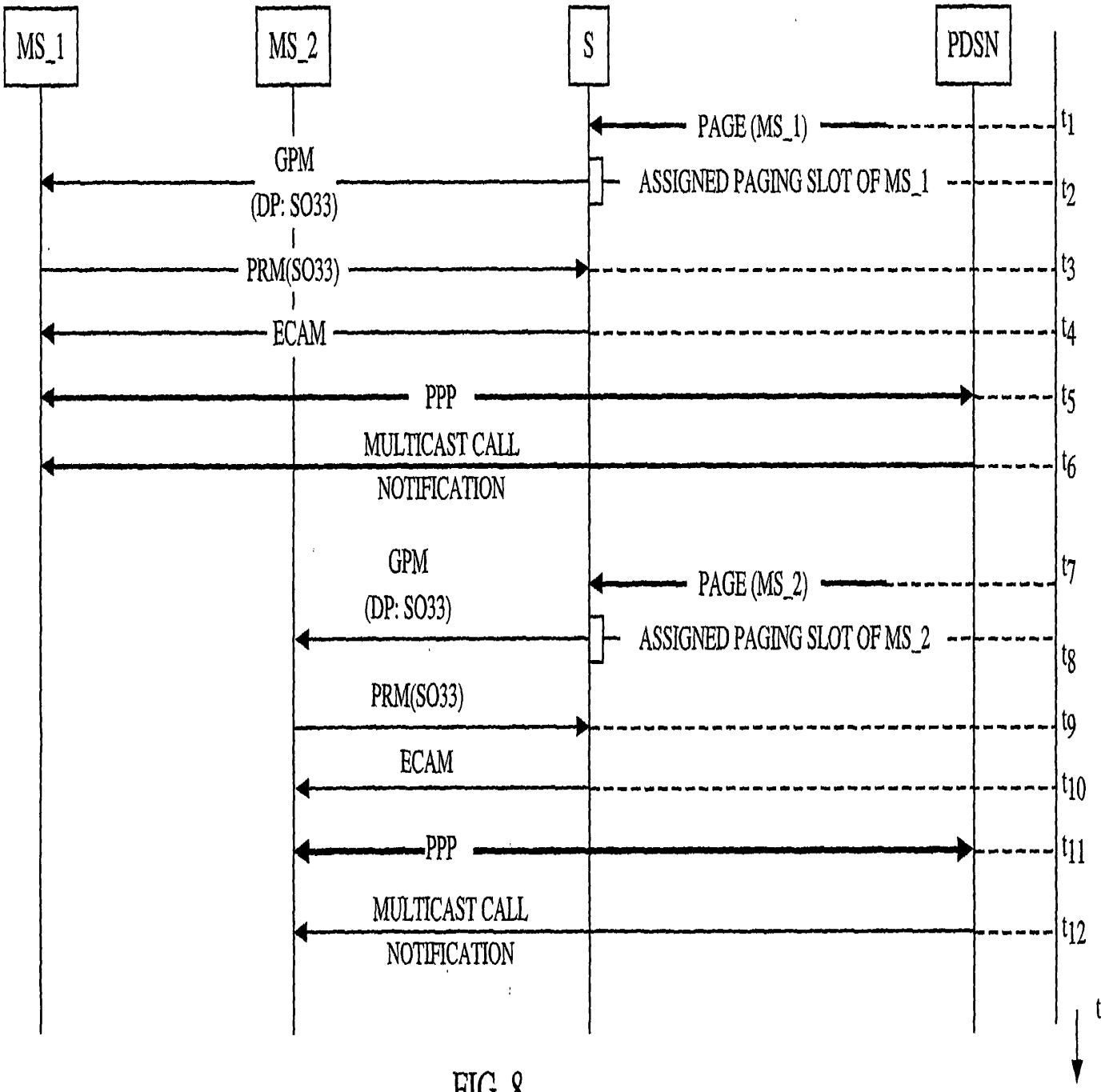

FIG. 8

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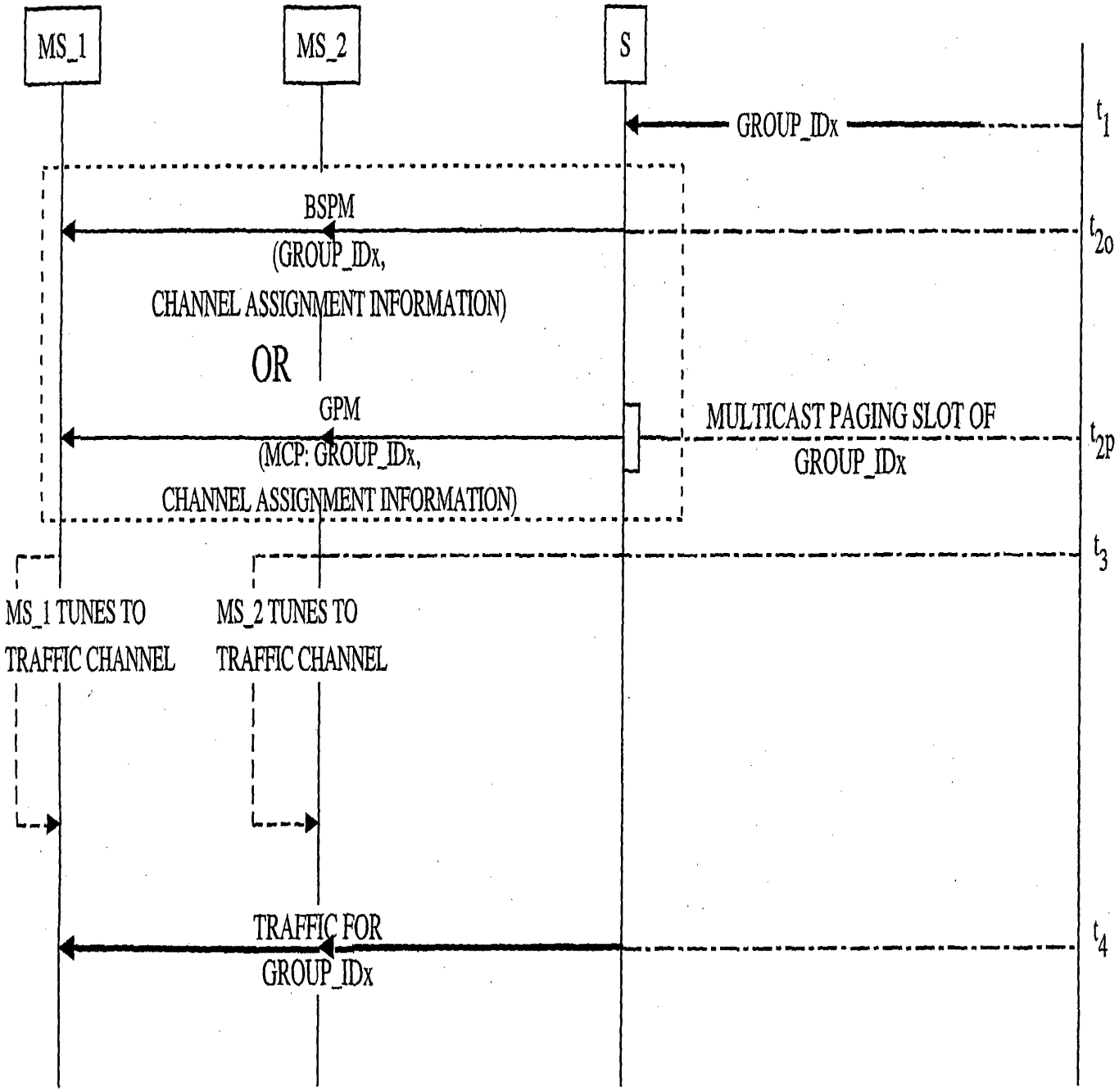

FIG. 9

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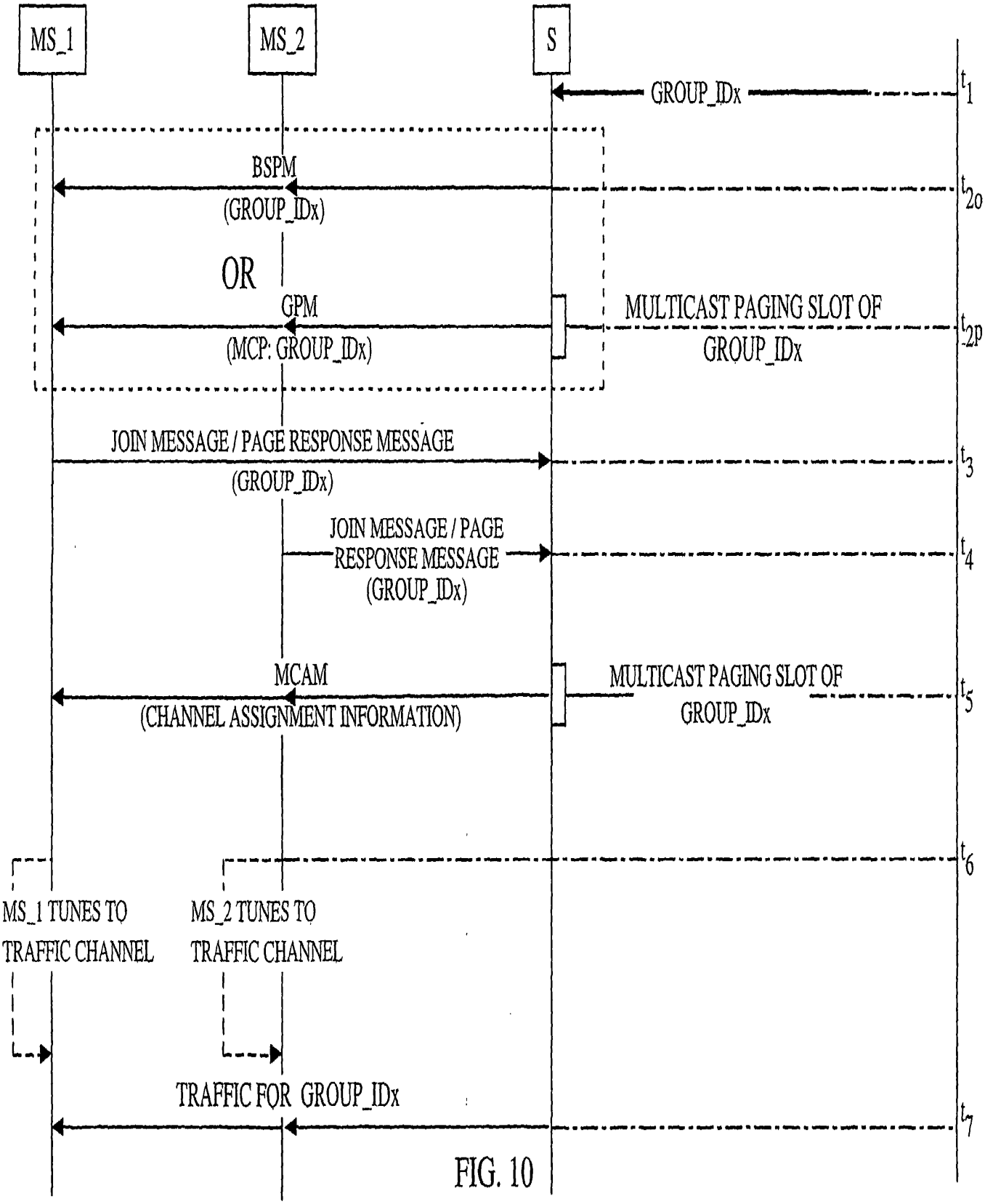

FIG. 10

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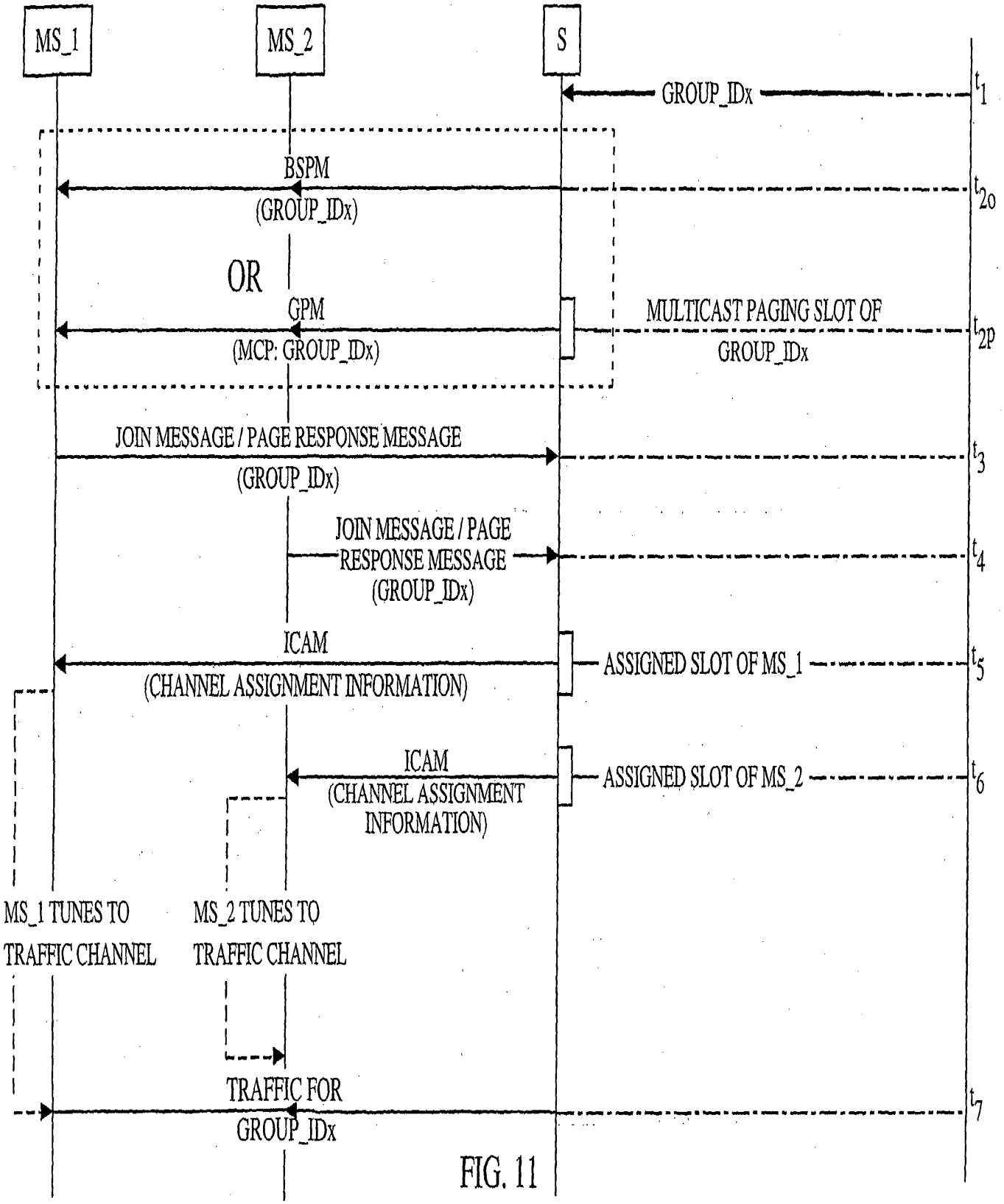

FIG. 11

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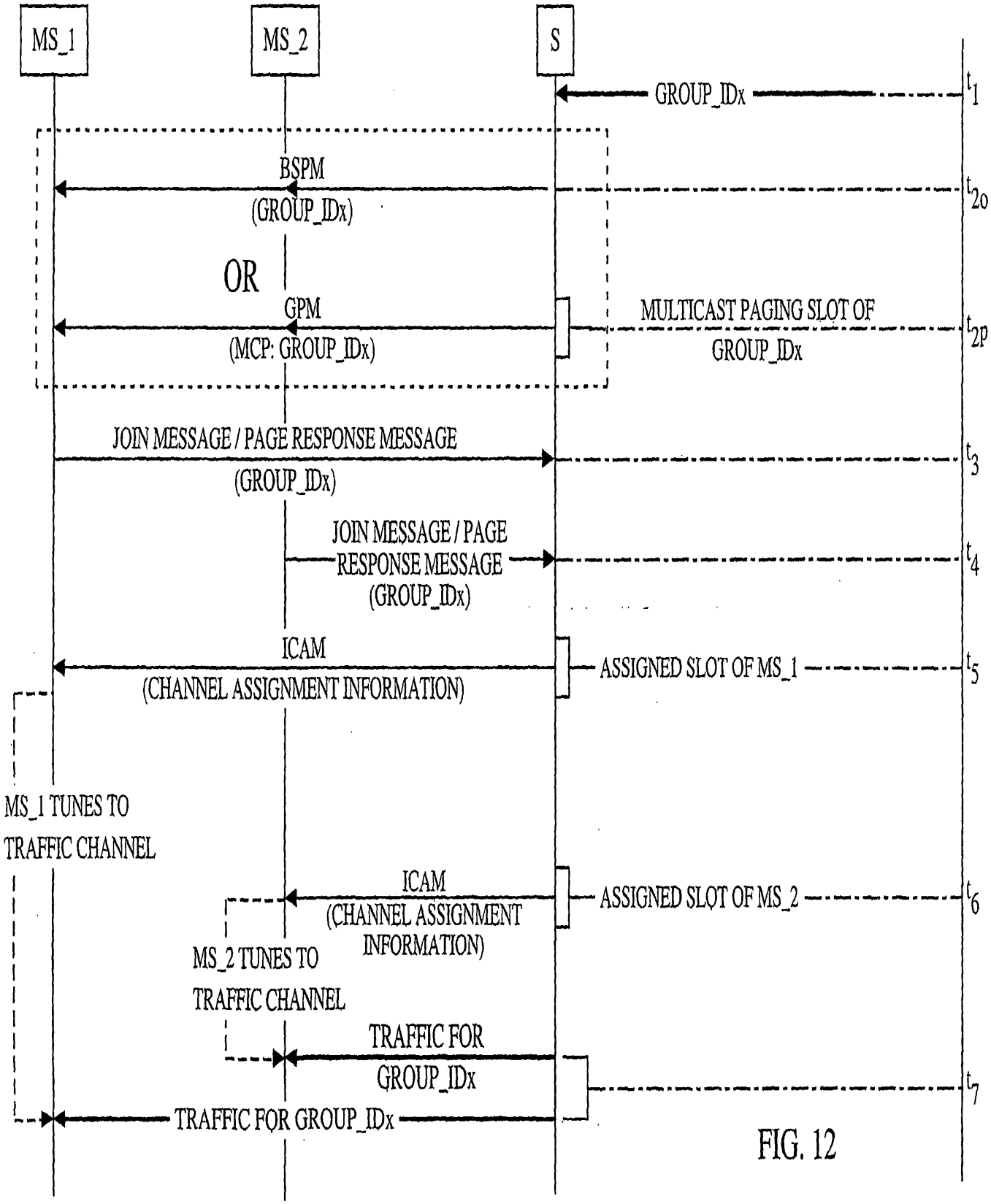

FIG. 12

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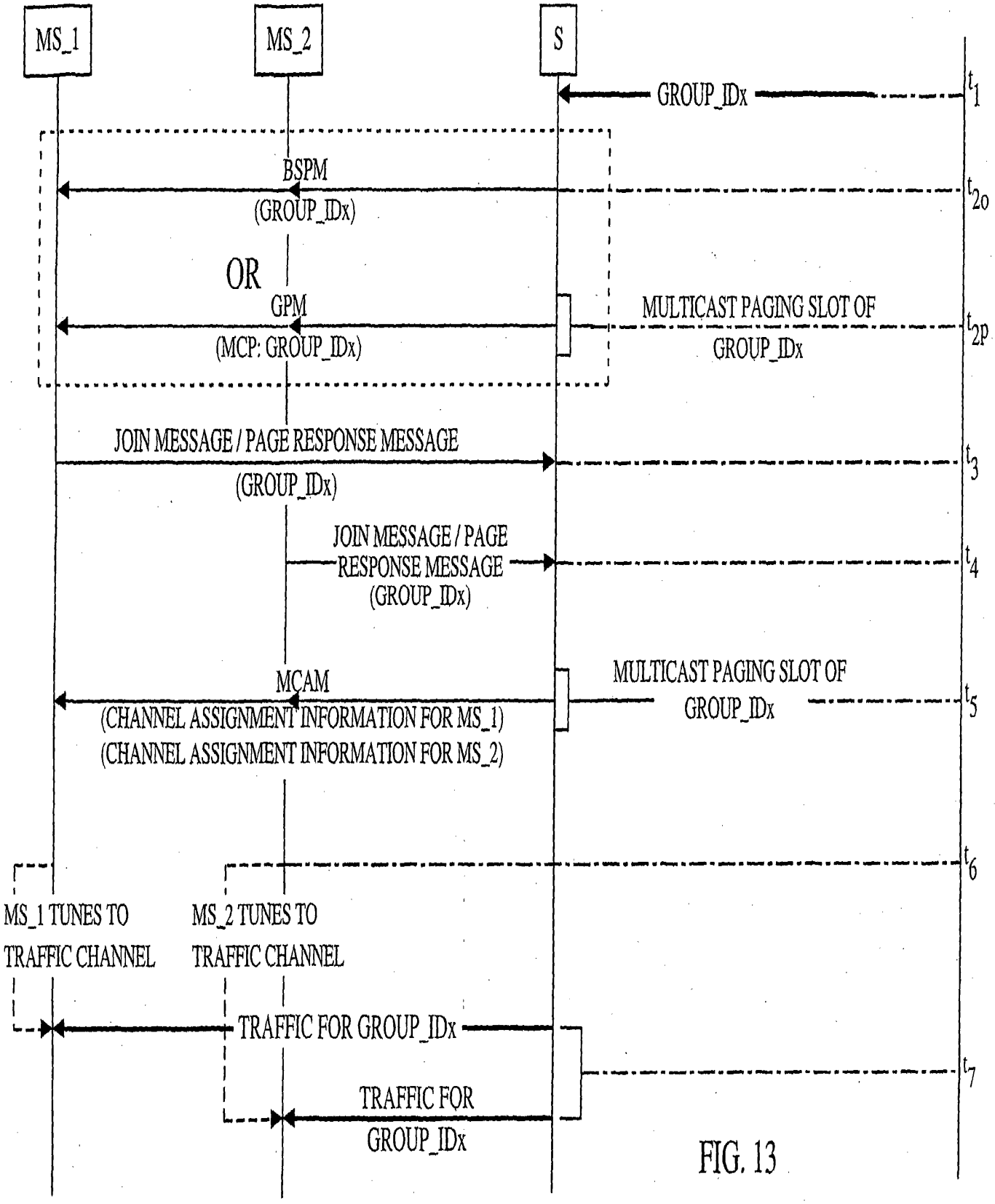

FIG. 13

RNSDOCID: <WO 2004006615A1 >

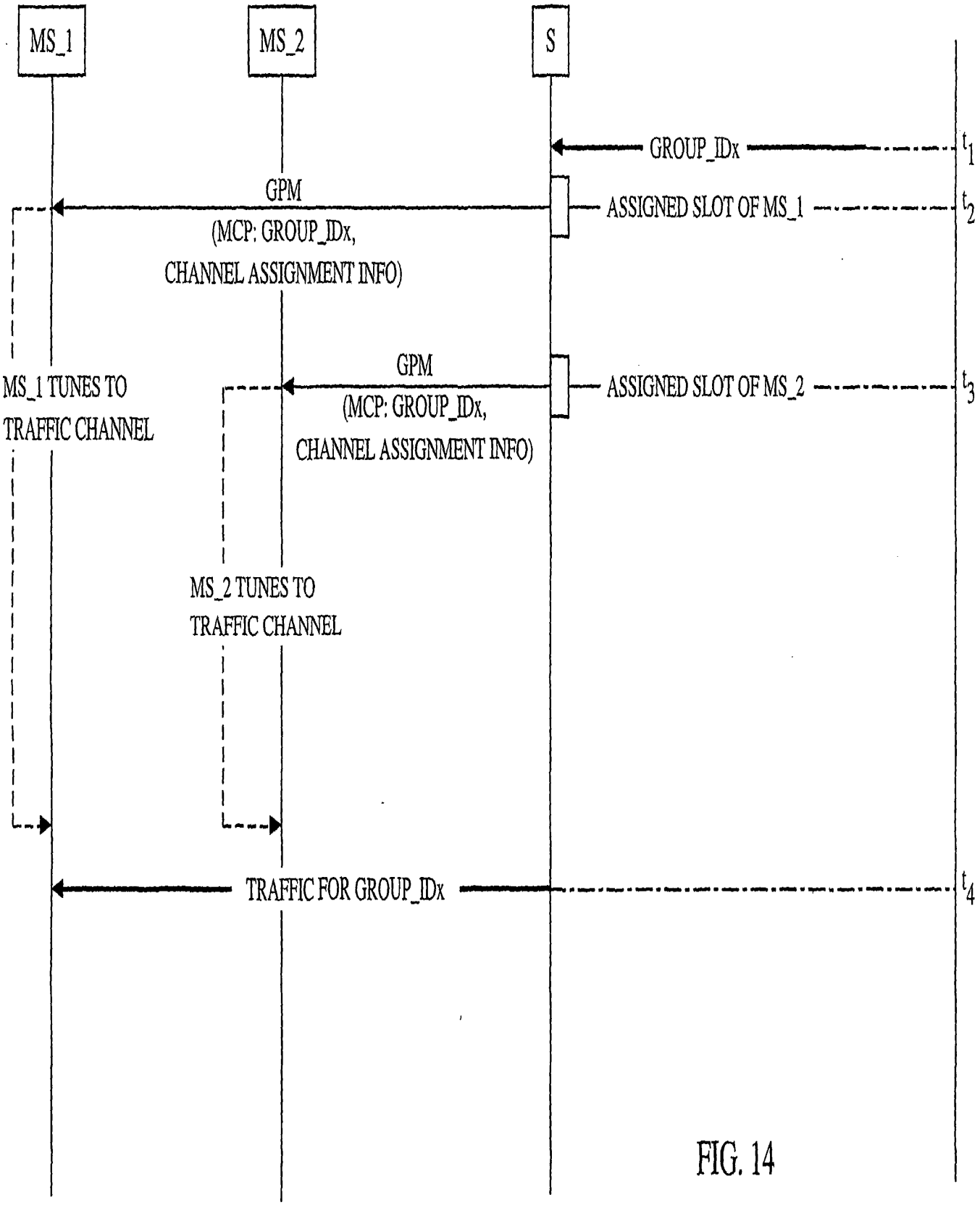

FIG. 14

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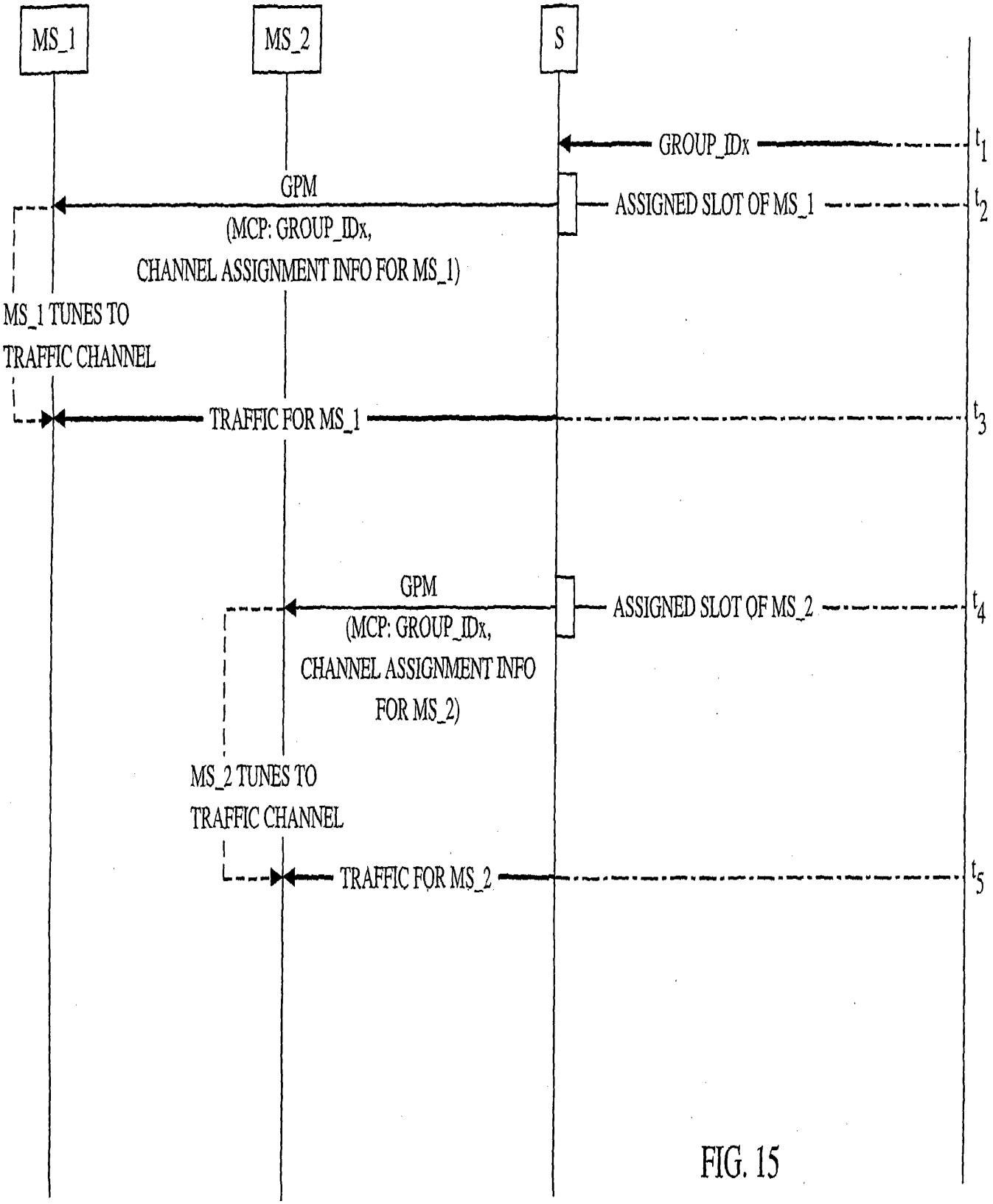

FIG. 15

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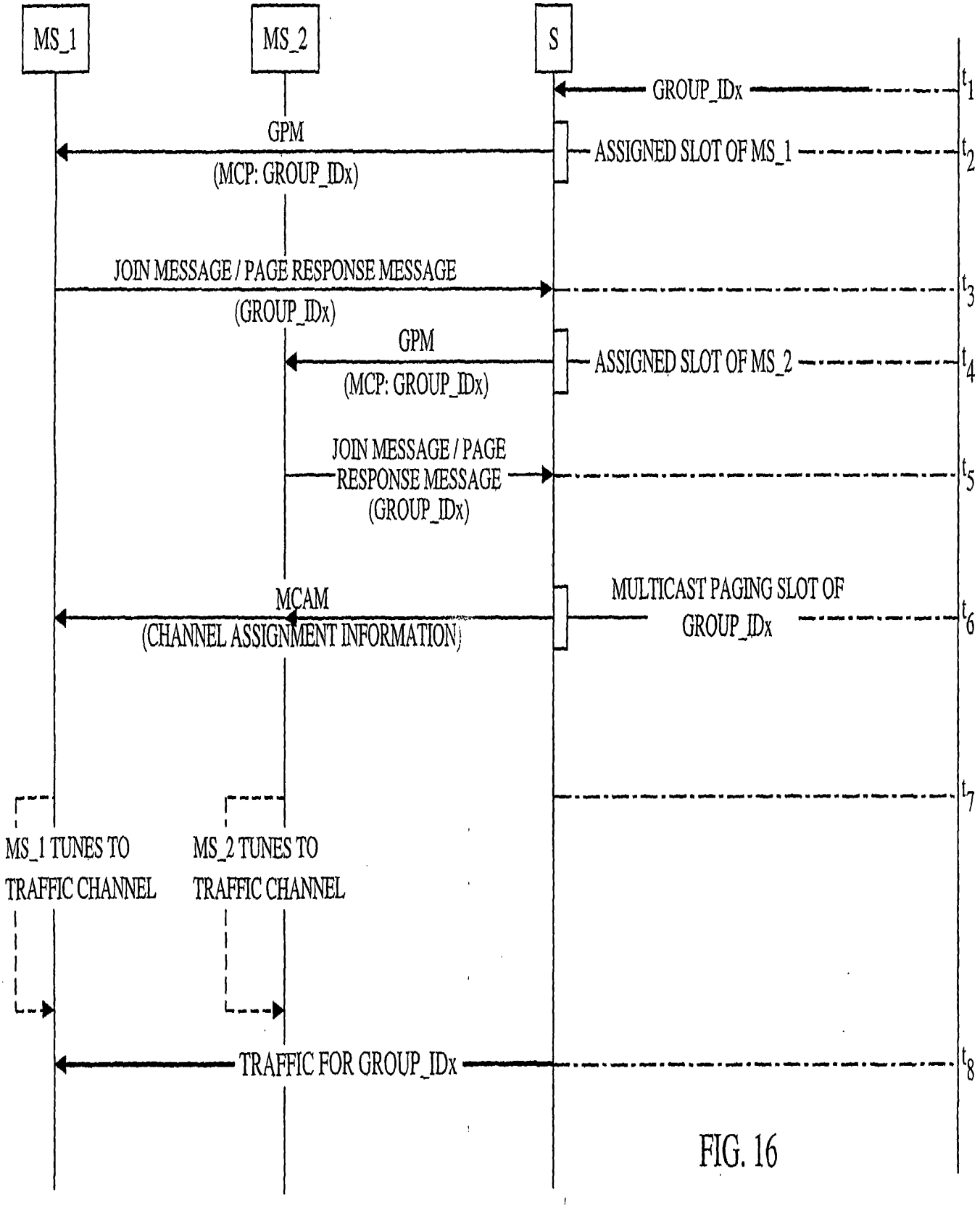

FIG. 16

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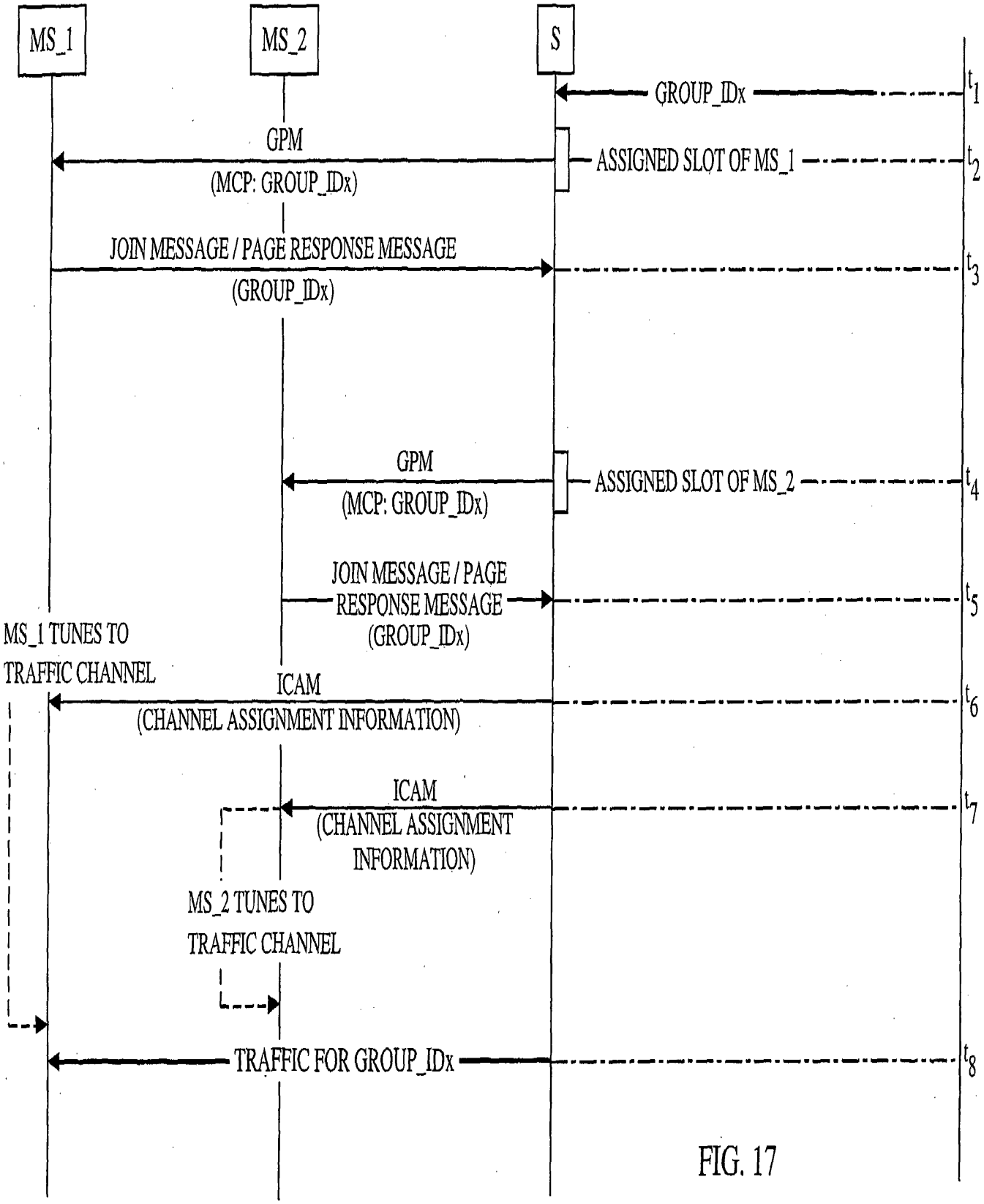

FIG. 17

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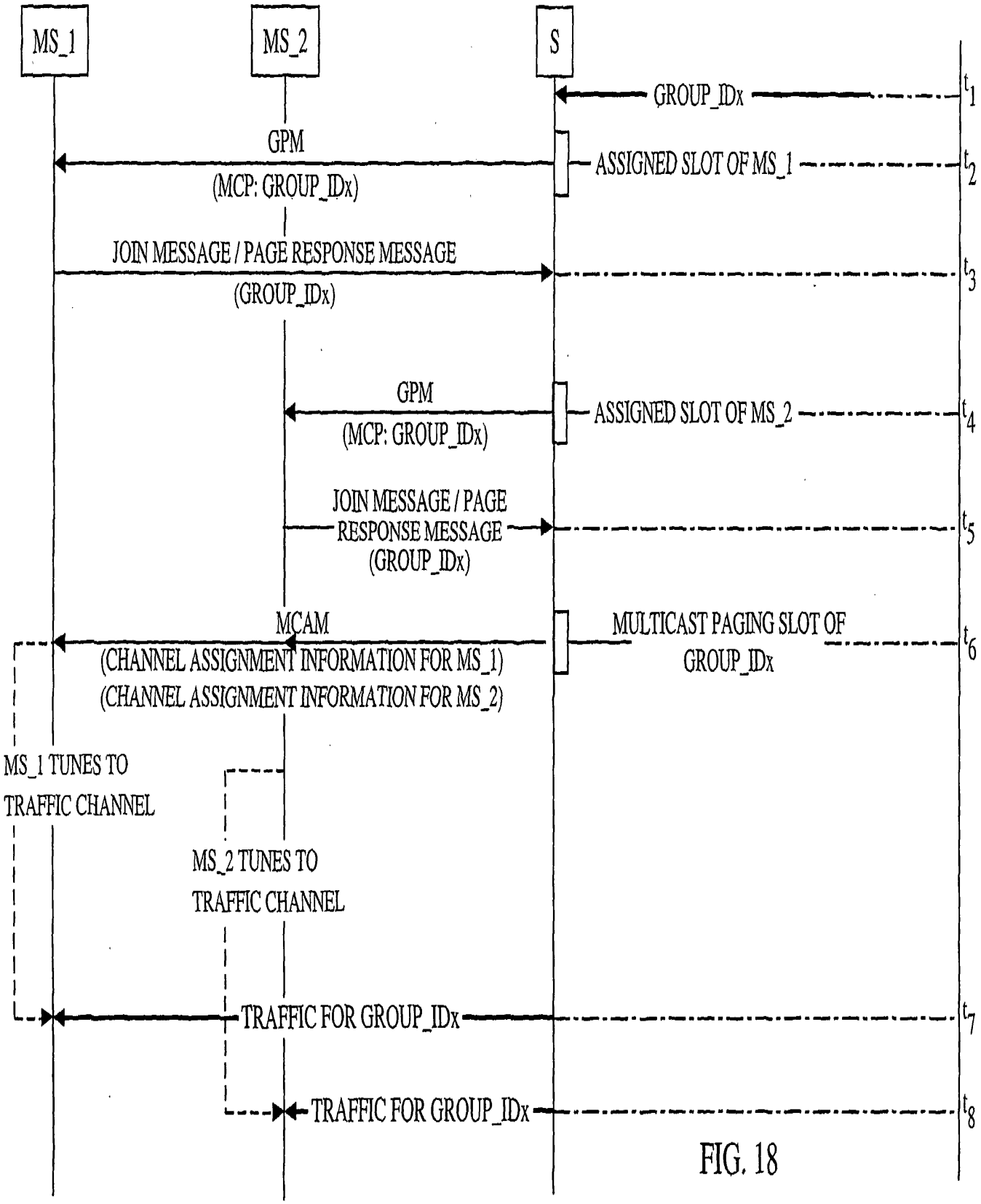

FIG. 18

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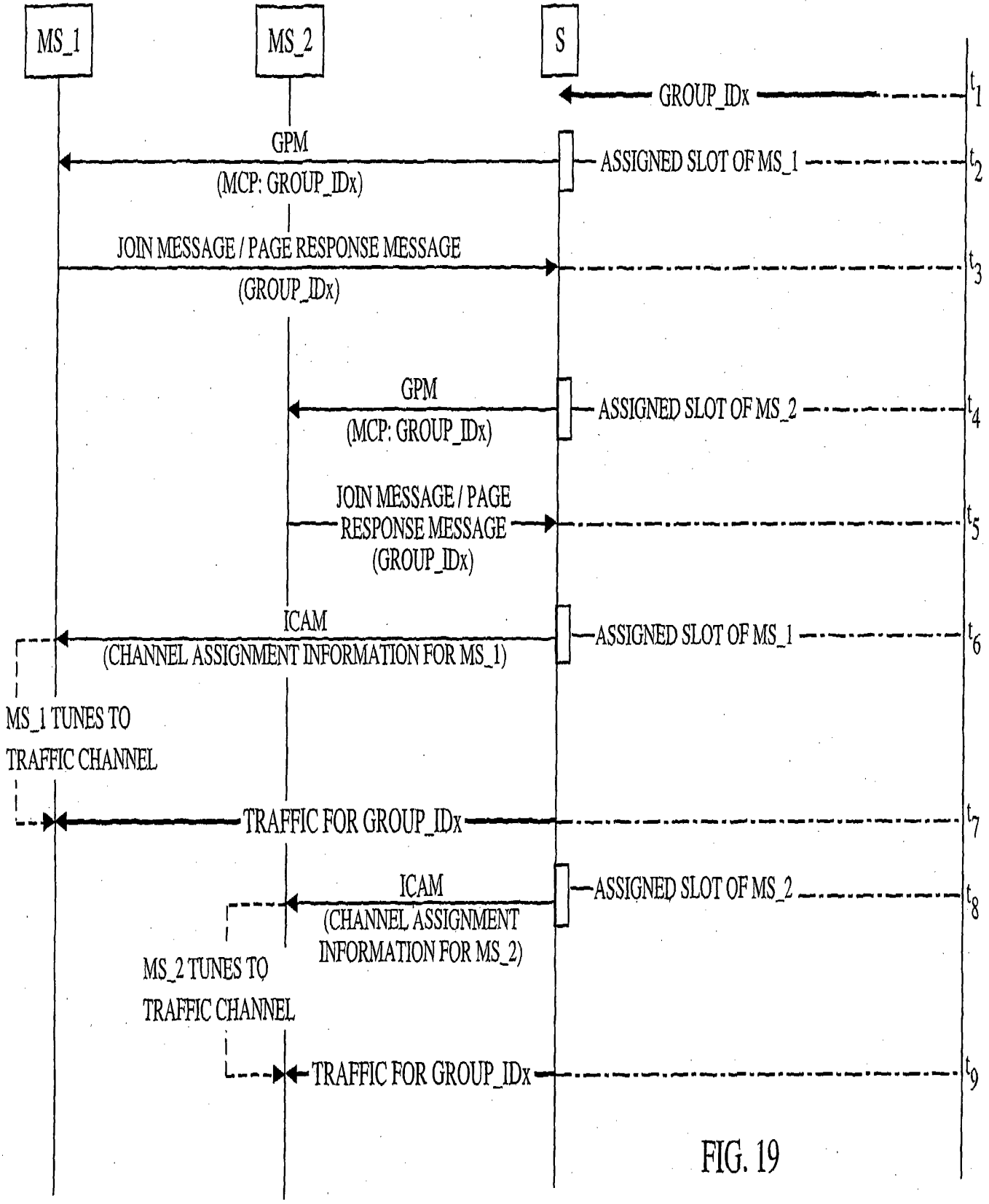

FIG. 19

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/21597

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 213 939 A (NOKIA CORP) 12 June 2002 (2002-06-12)	1-48, 50-53, 55-58, 60-64, 66-83, 85-104, 106-110, 112,113
Y	paragraphs '0003!-'0005!	49,54, 59,65, 84,105, 111
	paragraphs '0010!,'0011!,'0014!,'0023!	
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 November 2003	25/11/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Standaert, F

Form PCT/ISA/210 (second sheet) (July 1992)

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